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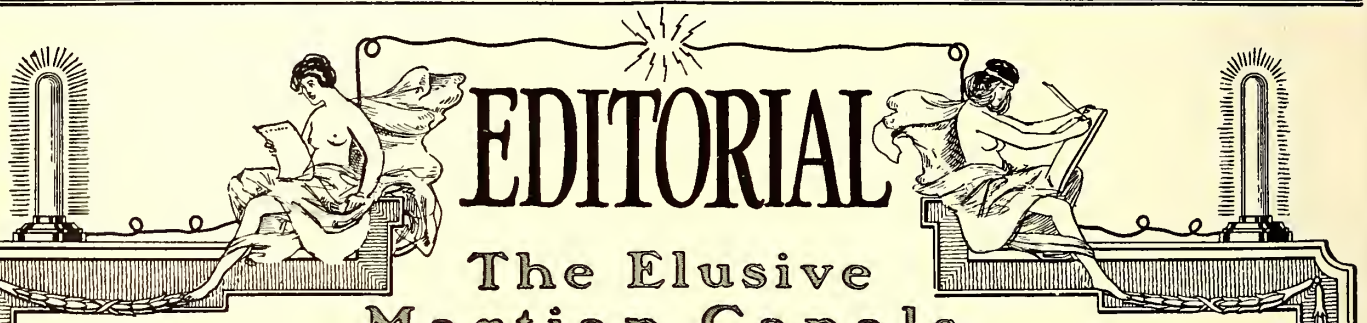

EDITORIAL

The Elusive Martian Canals

IN 1877 Schiaparelli, in his *Memoria,* published the first maps of the planet Mars, on which were shown for the first time *canali*—the now famous—or infamous—Martian canals. In Italian this word does not mean canal, but channel, and it is due mainly to this erroneous conception that the word canal was introduced into the English, French and German languages. Just the same it stuck from the beginning, altho Schiaparelli did not at first take his "channels" to be "canals," as we understand the term. For canal with us always means an artificial waterway, and this Schiaparelli did not claim.

From 1877 down to Lowell and Pickering, astronomers and scientists have waged one of the most remarkable scientific battles in history. Books by the dozens, pamphlets by the hundreds were printed and are printed this very minute, discussing the *pros* and the *cons* of the mysterious canals. The one camp—the largest by far—believes absolutely in the existence of the Martian canals, be they artificial or natural. Hundreds of astronomers have seen the net-like lines, criss-crossing the face of our sister planet by the hundreds in all directions.

The other camp—the minority—flatly denies all existence of these lines. Their contention is that what the other fellow sees is nothing more than an optical illusion. The followers of this theory have never been able to see the fine lines on Mars, or if they really did glimpse them they have been unconvinced, stoutly maintaining their belief that what they saw was, of course, an optical illusion. They follow up the argument with the triumphant "proof" that the photographic plate, which always tells the truth, has never been able to record any one of the Martian canals.

This sounds like a good argument, *for there is no clear record* of an actual photograph showing the canals on Mars.

It is true that the Lowell observatory actually *did* photograph some of the more prominent canals, but these show up exceedingly faint, and would not be considered evidence by non-believers.

Plausible as this argument is, it can only deceive laymen; the astronomer, however, will smile at it, for it is preposterous.

And here are the reasons: When we look at the Martian canals, the light rays pass thru two atmospheres, that of Mars and our own. The terrestrial atmosphere is about thirty-five miles thick and very dense. The air of Mars is thin and passes the light rays easily. Unless Mars is exactly overhead—and it is far from that when nearest to the earth—we would view it thru thirty-five miles of air. But we never do. More often, because Mars is many degrees from zenith, we view it thru hundreds of miles of air. And this is what makes all the trouble. The air is nearly always in motion—very seldom the "seeing," as astronomers call it, is perfect. So when we attach a camera to our telescope the fine lines become blurred, due to the distortion, and consequently do not register on the plate. But there are several other reasons why we cannot photograph the canals. One is because the grain in the photographic plate is too coarse to show such exceedingly fine lines. Take a silk sewing thread and stretch it across your yard. You can see it readily in bright sunlight thirty or forty yards away, but the best photographic snapshot will not be able to register a trace on the sensitized plate.

Another important reason why we cannot photograph the canals is, because we cannot take instantaneous pictures for the reason that the light received from Mars is rather weak, and if we take a short-time exposure the moving atmosphere tends to blur the picture.

H. GERNSBACK.

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"I was astounded at my new power over men and women. People actually went out of their way to do things for me, they seemed EAGER TO PLEASE ME"

The Secret of Making People Like You

"Getting people to like you is the quick road to success—it's more important than ability," says this man. It surely did wonders for him. How he does it—a simple method which anyone can use instantly.

ALL the office was talking about it, and we were wondering which one of us would be the lucky man.

There was an important job to be filled — as Assistant-to-the President. According to the general run of salaries in the office, this one would easily pay from $7,000 to $10,000 a year.

The main requisite, as we understood it, was striking personality and the ability to meet even the biggest men in their offices, their clubs, and their homes on a basis of absolute equality. This the firm considered of even more importance than knowledge of the business.

You know just what happens when news of this sort gets around an office. The boys got to picking the man among themselves. They had the choice all narrowed down to two men—Harrison and myself. That was the way I felt about it, too. Harrison was big enough for the job, and could undoubtedly make a success of it. But, personally, I felt that I had the edge on him in lots of ways. And I was sure that the firm knew it, too.

Never shall I forget my thrill of pleasure when the president's secretary came into my office with a cheery smile, looked at me meaningly, handed me a bulletin and said, "Mr. Frazer, here is the news about the new Assistant-to-the-President." There seemed to be a new note of added respect in her attitude toward me. I smiled my appreciation as she left my desk.

At last I had come into my own! Never did the sun shine so brightly as on that morning, and never did it seem so good to be alive! These were my thoughts as I gazed out of the window, seeing not the hurrying throngs, but vivid pictures of my new position flashing before me. And then for a further joyous thrill I read the bulletin. It said, "Effective January 1, Mr. Henry J. Peters, of our Cleveland office, will assume the duties of Assistant-to-the-President at the home office."

Peters! Peters!—surely it *couldn't* be Peters! Why, this fellow Peters was only a branch-office salesman. . . . *Personality!* Why, he was only five feet four inches high, and had no more personality than a mouse. Stack him up against a big man and he'd look and act like an office boy. I knew Peters well and there was nothing to him, nothing at all.

January the first came and Peters assumed his new duties. All the boys were openly hostile to him. Naturally, I felt very keenly about it, and didn't exactly go out of my way to make things pleasant for him—not exactly!

But our open opposition didn't seem to bother Peters. He went right on with his work and began to make good. Soon I noticed that, despite my feelings against him, I was secretly beginning to admire him. He was winning over the other boys, too. It wasn't long before we all buried our little hatchets and palled up with Peters.

The funny thing about it was the big hit he made with the people we did business with. I never saw anything like it. They would come in and write in and telephone in to the firm and praise Peters to the skies. They insisted on doing business with him, and gave him orders of a size that made us dizzy to look at. And offers of positions! why, Peters had almost as many fancy-

figure positions offered to him as a dictionary has words.

What I could not get into my mind was how a little, unassuming, ordinary-to-look-at-chap like Peters could make such an impression with everyone—especially with influential men. He seemed to have an uncanny influence over people. The masterly Peters of today was an altogether different man from the commonplace Peters I had first met years ago. I could not figure it out, nor could the other boys.

One day at luncheon I came right out and asked Peters how he did it. I half expected him to evade. But he didn't. He let me in on the secret. He said he was not afraid to do it as there was always plenty of room at the top.

"People would come in and write in and telephone in and praise Peters to the skies . . . he was showered with offers of fancy figure positions."

What Peters told me acted on my mind in exactly the same way as when you stand on a hill and look through binocular glasses at objects in the far distance. Many things I could not see before suddenly leaped into my mind with startling clearness. A new sense of power surged through me. And I felt the urge to put it into action.

Within a month I was getting remarkable results. *I had suddenly become popular.* Business men of importance who had formerly given me only a passing nod of acquaintance, suddenly showed a desire for my friendship. I was invited into the most select social circles. People—even strangers—actually went out of their way to do things for me. At first I was astounded at my new power over men and women. Not only could I get them to do what I wanted them to do but they actually anticipated my wishes and seemed eager to *please me.* But let me tell you some of my experiences.

One of our biggest customers had a grievance against the firm. He held off payment of a big bill and switched to one of our competitors. I was sent to see him. He met me liked a cornered tiger. A few words and I calmed him. Inside of fifteen minutes he was showering me with apologies. He gave me a check in full payment, another big order, and promised to continue giving us all his business.

For certain reasons it became necessary for the firm to obtain a signed letter from a prominent public man. Three of our men had tried, and failed. Then I was given the job. I felt I had been made the "goat." But I got the signed letter, and with it an inside tip which enabled us to land a prize order about which our competitors are still guessing and wondering.

Then trouble sprang up at one of our factories. Then men talked strike. Things looked ugly. I was sent to straighten it out. On the eve of a general walkout, I pacified the men and headed off the strike. And not only this, but ever since then this factory has led all our other plants in production.

I could tell you dozens of similar instances, but they all tell the same story—the ability to make people like you, believe what you want them to believe, and to do what you want them to do. I take no personal credit for what I have done. All the credit I give to the method Peters told me about. We have told it to lots of our friends, and it has enabled them to do just as remarkable things as Peters and I have done.

Which reminds me: One of my wife's close friends moved to another town where she was a stranger. My wife of course knew of my method. She told it to her friend with the idea that it might be of assistance to her in meeting new people. It helped her so wonderfully that in a very short time she won the close friendship of many of the "best families" in the town. Every one wonders how she did it. But WE know.

But you want to know what method I used to do all these remarkable things. It is this: You know that every one doesn't think alike. What one likes another dislikes. What pleases one offends another. And what offends one pleases another. Well, there is your cue. You can make an instant hit with any one if you say the things they want you to say, and act the way they want you to act. Do this and they will surely like you, and believe in you, and will go miles out of their way to PLEASE YOU.

You can do this easily by knowing certain simple signs. Written on every man, woman and child are signs, as clearly and as distinctly as though they were in letters a foot high, which show you from one quick glance exactly what to say and to do to please them—to get them to believe what you want them to believe—to think as you think—to do exactly what you want them to do.

In knowing these simple signs is the whole secret of getting what you want out of life—of making friends, of business and social advancement. Every great leader uses this method. That is why he IS a leader Use it yourself and you will quickly become a leader—nothing can stop you. And you will want to use it for no other reason than to protect yourself against others.

What Peters told me at luncheon that day was this: "Get Dr. Blackford's 'Reading Character at Sight.'" I did so. This is how I learned to do all the remarkable things I have told you about.

You have heard of Dr. Blackford, the Master Character Analyst. Many concerns will not employ a man without first getting Dr. Blackford to pass on him. Concerns such as Westinghouse Electric and Manufacturing Company, Baker-Vawter Company, Scott Paper Company and many others pay Dr. Blackford large annual fees for advice on dealing with human nature.

So great was the demand for these services that Dr. Blackford could not even begin to fill all the engagements. So Dr. Blackford has explained the method in a simple seven-lesson course entitled "Reading Character at Sight." Even a half hour's reading of this remarkable course will give you an insight into human nature and a power over people which will surprise you.

Such confidence have the publishers in Dr. Blackford's course, "Reading Character at Sight," that they will gladly send it to you on approval. Send no money. Merely fill in and mail the coupon. The complete course will go to you instantly, on approval, all charges prepaid. Look it over thoroughly. See if it lives up to the claims made for it. If you do not want to keep it, then return it, and the transaction is closed. And if you decide to keep it—as you surely will—then merely remit Five Dollars in full payment.

Remember, you take no risk, you assume no obligation. The entire course goes to you on approval. You've everything to gain—nothing to lose. So mail the coupon NOW, while this remarkable offer remains open.

"In a very short time she won the close friendship of many of the 'best families' in town"

Why Some Foods Explode in the Stomach

And How 48 Hours Makes New Stomachs from Old

By R. S. THOMPSON

A MAN'S success in life depends more on the co-operation of his stomach than on any other factor. Just as an "army moves on its stomach" so does the individual. Scientists tell us that 90% of all sickness is traceable to the digestive tract. Yet in a surprisingly large number of cases even chronic stomach trouble can be remedied in from 48 to 72 hours.

Physical efficiency is the back-bone of mental efficiency. Unless our stomachs are effectively performing their functions in the way Nature intended, we can't be physically fit. And unless we're physically fit, we can't be thoroughly successful.

As Dr. Orison Swett Marden, the noted writer, says, "the brain gets an immense amount of credit which really should go to the stomach." And it's true — keep the digestive system in shape and brain vitality is assured.

Of course, there are successful men who have weak digestions, but they are exceptions to the rule. They succeeded *in spite* of their physical condition. Ten times the success would undoubtedly be theirs if they had the backing of a strong physique and a perfect stomach. There are a thousand men who owe their success in life to a good digestion to every one who succeeded in spite of a poor digestion and the many ills it leads to.

The cause of practically all stomach disorders — and remember, stomach disorders lead to 90% of all sickness —is wrong eating.

Food is the fuel of the human system, yet some of the combinations of food we put into our systems are as dangerous as dynamite, soggy wood and a little coal would be in a furnace—and just about as effective. Is it any wonder that the average life of man today is but 39 years — and that diseases of the stomach, liver, and kidneys have increased 103% during the past few years!

The trouble is that no one has, until recently, given any study to the question of food and its relation to the human body. Very often one good harmless food when eaten in combination with other harmless foods creates a chemical reaction in the stomach and literally explodes, giving off dangerous toxics which enter the blood and slowly poison our entire system, sapping our vitality and depleting our efficiency in the meantime.

And yet, just as wrong food selections and combinations will destroy our health and efficiency, so will the right foods create and maintain bodily vigor and mental energy. And by right foods we do not mean freak foods — just good, every-day foods properly combined. In fact, to follow Corrective Eating it isn't even necessary to upset your table.

Not long ago I had a talk with Eugene Christian, the noted food scientist, and he told me some of his experiences in the treatment of disease through food. Incidentally Eugene Christian has personally treated over 23,000 people for almost every non-organic ailment known, with almost unvaried success. An enviable record when one considers that people nearly always go to him after every other known method has failed. And the remarkable part of it all is that Eugene Christian's methods often remedy chronic cases of stomach trouble in 48 hours.

One case which interested me greatly was that of a young business man whose efficiency had been practically wrecked through stomach acidity, fermentation and constipation, resulting in physical sluggishness which was naturally reflected in his ability to use his mind. He was twenty pounds under weight when he first went to see Christian and was so nervous he couldn't sleep. Stomach and intestinal gases were so severe that they caused irregular heart action and often fits of great mental depression. As Christian describes it, he was not 50 per cent efficient either mentally or physically. Yet in a few days, by following Christian's suggestions as to food, his constipation had completely gone, although he had formerly been in the habit of taking large daily doses of a strong cathartic. In five weeks every abnormal symptom had disappeared—his weight having increased six pounds. In addition to this he acquired a store of physical and mental energy so great in comparison with his former self as to almost belie the fact that it was the same man.

Another instance of what proper food combinations can do was that of a man one hundred pounds overweight whose only other discomfort was rheumatism. This man's greatest pleasure in life was eating. Though convinced of the necessity, he hesitated for months to go under treatment, believing he would be deprived of the pleasure of the table. He finally, however, decided to try it out. Not only did he begin losing weight at once, quickly regaining his normal figure, all signs of rheumatism disappearing, but he found the new diet far more delicious to the taste and afforded a much keener quality of enjoyment than his old method of eating, and he wrote Christian a letter to that effect.

But perhaps the most interesting case that Christian told me of was that of a multi-millionaire—a man 70 years old, who had been traveling with his doctor for several years in a search for health. He was extremely emaciated, had chronic constipation, lumbago, and rheumatism. For over twenty years he had suffered from stomach and intestinal trouble which in reality was super-aciduous secretions in the stomach. The first menus given him was designed to remove the causes of acidity, which was accomplished in about thirty days. And after this was done he seemed to undergo a complete rejuvenation. His eyesight, hearing, taste, and all of his mental faculties became keener and more alert. He had had no organic trouble—but he was starving to death from malnutrition and decomposition—all caused by the wrong selection and combination of foods. After six months' treatment this man was as well and strong as he had ever been in his life.

These instances of the efficacy of right eating I have simply chosen at random from perhaps a dozen Eugene Christian told me of, every one of which was fully as interesting, and they applied to as many different ailments. Surely this man Christian is doing a great work.

I know of several instances where rich men and women have been so pleased with what he has done for them that they have sent him checks for $500 or $1,000 in addition to the amount of the bill when paying him.

There have been so many inquiries from all parts of the United States from people seeking the benefit of Eugene Christian's advice and whose cases he is unable to handle personally that he has written a course of little lessons which tell you exactly what to eat for health, strength and efficiency. This course is published by The Corrective Eating Society of New York.

These lessons, there are 24 of them, contain actual menus for breakfast, luncheon, and dinner, curative as well as corrective, covering every condition of health and sickness from infancy to old age and for all occupations, climates, and seasons, including special summer menus which enable you to withstand the heat and retain winter's vigor.

Reasons are given for every recommendation based upon actual results secured in the author's many years of practice. Technical terms have been avoided —every point is explained so clearly that there can be no possible misunderstanding.

With these lessons at hand it is just as though you were in personal contact with the great food specialist, because every possible point is so thoroughly covered that you can scarcely think of a question which isn't answered. You can start eating the very things that will produce the increased physical and mental energy you are seeking the day you receive the lessons and will find that you secure results with the first meal. And if you suffer from acid stomach it is quite likely that your trouble will successfully be overcome in from 48 to 72 hours.

If you would like to examine these 24 Little Lessons in Corrective Eating, simply write The Corrective Eating Society, Inc., Dept. 16410, 443 Fourth Avenue, New York City. It is not necessary to enclose any money with your request. Merely ask them to send the lessons on five days' trial, with the understanding that you will either return them within the time or remit $3.00, the small fee asked.

The reason that the Society is willing to send the lessons on free examination without money in advance is because they want to remove every obstacle to putting this knowledge in the hands of the many interested people as soon as possible, knowing full well that a test of some of the menus in the lessons themselves is more convincing than anything that can possibly be said about them.

Please clip out and mail the following form instead of writing a letter, as this is a copy of the official blank adopted by the Society, and will be honored at once.

CORRECTIVE EATING SOCIETY, INC.
Dept. 16410, 443 Fourth Ave., New York City

You may send me prepaid a copy of Corrective Eating in 24 Lessons. I will either remail them to you within five days after receipt or send you $3.

Name .....

Address .....

City .....State.....

In one way or another your whole income is staked upon your memory every day!

A Simple Test To Measure Your Memory

Could You Get By With This Big Employer Who Judges His Men On What Their Minds Retain? Try It.

NOT long ago a large eastern concern was looking for a man to fill an important position as district manager.

Several hundred applications for the job were received. The choice finally narrowed down to four names, and from these the successful candidate was to be selected.

Before the decision was made these four men were asked to do what seemed to them a most unusual thing. They were put through a test such as they had never before heard of, and each man understood that he would be judged, to a large extent, on the showing he made.

The job was filled at last and the man who won out was probably more surprised at his success than any of the others would have been had they gotten it. He knew that his experience was far less than that of two of the applicants, he was younger than any of them and it had seemed to him all along that his case was anything but hopeful. He determined to find out just why the firm put so much reliance on the simple test that each man had been asked to take.

"That little device is one of our most valuable aids in finding the men we want as employees", an officer of the company told him. "We apply it to every person who seeks a position with us from office boys up to high priced executives. The result is that our whole organization is a great deal more efficient than in the old days.

David M. Roth

"We borrowed the test from the works of David M. Roth, the memory expert, and it is our experience that one of the surest ways to know a man's mental power is to measure his memory. The fellow with a good memory has the qualities that go with a good memory and those are the things we pay big salaries for."

THIS firm had installed in a special room a replica of a store show-window facing into the room as a real store window faces the street. Behind its glass were arranged perhaps fifty different articles which were manufactured by the company itself and formed a part of their regular line. The window was well lighted and every article in it was something familiar to all.

Each man who takes the test is permitted 30 seconds to observe and memorize the objects in the window. Then he is required to leave the room and write down as many as he can remember. The proportion of them that he is able to recall determines his memory rating and, largely, his chances for getting the job.

You can measure your memory at home by means of this same test. Have someone select and arrange twenty-five articles of ordinary household use on a table. Let those who are taking the test observe them in silence for 15 seconds. Then let each person go into another room and write down the names of as many of the articles as he can remember. The result will reveal a surprising state of affairs. It will dismay you to find how quickly and absolutely the names of familiar articles, some of which perhaps you see and use every day, will slip out of your mind and refuse to return.

But the most interesting part of this test is the way it exposes the tremendous handicap you are struggling under in your daily work.

When you find what a small number of the articles on the table you are able to name after the most intense effort to impress them on your mind you begin to realize how many facts of value, how much useful knowledge, how many names, faces and figures that would make you a better man in your job drop out of your mind and are gone, leaving you in point of knowledge and experience barely ahead of where you were the month before or the year before.

Do you wonder at the importance of the memory test in hiring men for high-salaried permanent positions? Can you doubt the tremendous money value of a trained, dependable memory in business and the professions?

A STRIKING instance of this very thing came to light recently.

Forty years ago in the state of Virginia a boy of thirteen was forced to quit school and go to work when his father died. He became an apprentice in a blacksmith shop.

Today he is Vice President in charge of Production of the American Locomotive Company and one of the biggest executives in the country. He is C. K. Lassiter and his job is one of the hardest in all the range of American business. He keeps six plants with thousands of employees running smoothly. He knows every detail of the machinery in every one of these plants. He has to see that the company's locomotives are turned out on schedule time, and that each one reaches its buyer in good condition and working order.

In an interview with Mr. Lassiter appearing in the **American Magazine** for May, 1919, he says:

"My memory is today my greatest asset in business. . . . I learned to work for knowledge and to hold on to what I gained."

Such testimony is the usual thing from big leaders in all lines of work. It is because a good memory is so much more than the mere ability to recall the name of the man you met last week or the telephone number which you neglected to write down. These are merely the smaller conveniences of a good memory—the daily advantages that make you more efficient.

But in its larger phases, power of memory is power of judgment, power of foresight, power of knowledge. It matters very little what you learn today if the benefit of your experience is not with you tomorrow, or a year from tomorrow. Your judgment is only as good as your memory, because all sound decisions must be based on something learned in the past. Otherwise they are mere guesses, —gambles.

Foresight,—that quality which marks the most successful men everywhere—is nothing more nor less than applied memory. We can only foresee what **may** occur from our experience of what **has** occurred in the past. A simple matter of memory.

And all knowledge itself exists only through the ability to remember things that have been learned, information gained through experience, facts that have come to our attention at one time or another, ideas that have reached us from all sources and the knowledge of others expressed to us in speech or in printed words.

SO it is that the words "I forgot", and all these words stand for, have come to be regarded by men generally as a confession of needless weakness and an admission of failure.

And it has been David M. Roth who has showed the world just how needless a poor memory is. He has given to the public the secret of how to improve even a poor memory in a single evening. By the Roth Method hundreds of thousands of people all over the country have discovered for themselves that it is easy to have a sure-fire memory. And they have gained clearer thinking powers, stronger leadership and better self-possession along with their better memories.

One man not long ago wrote to Mr. Roth:

"You should have said that any person can improve their memory in two hours."—Charles A. Horan, 1541 W. Lehigh Ave., Philadelphia, Pa.

and another:

"The Roth Memory Course has been worth hundreds of dollars to me already."—L. D. Smith, Buffalo, Okla.

Such letters come in by the hundreds from men and women who asked to see the seven lessons of the Roth Memory Course while half in doubt about its simplicity, usefulness and power to build a leakproof memory. They have become as enthusiastic as you will be when you find that a better memory is so easy to have and so close at hand.

PROVE it? Mr. Roth, through his publishers, The Independent Corporation, gladly assumes that burden.

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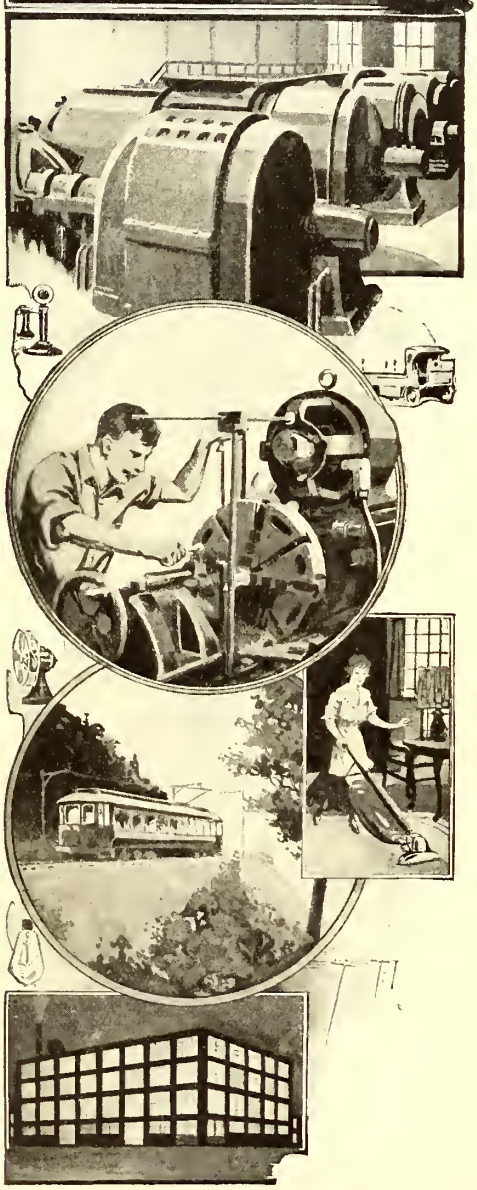

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ELECTRICAL EXPERIMENTER

H. GERNSBACK – EDITOR
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Vol. VII. Whole No. 78 OCTOBER, 1919 No. 6

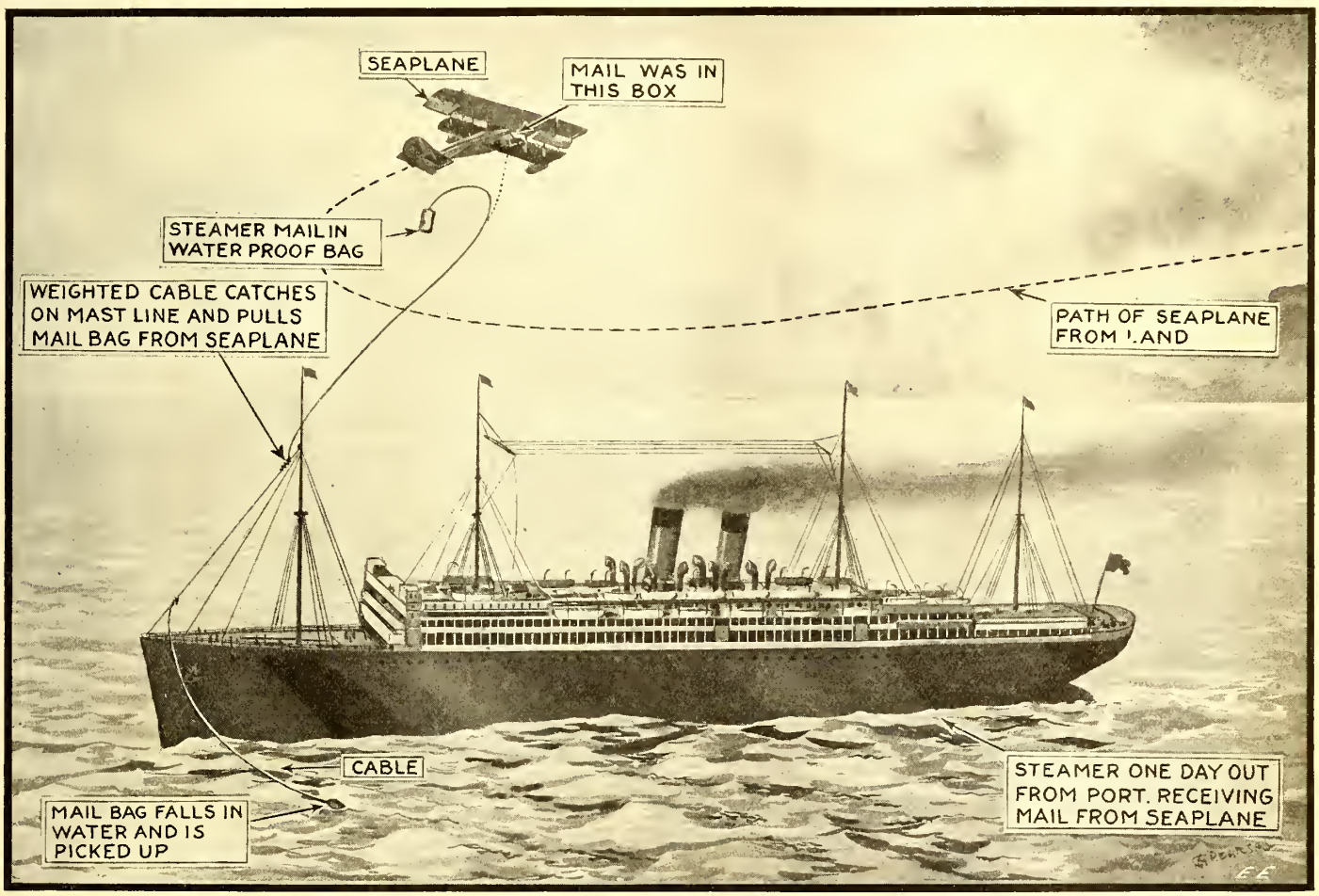
Seaplane Delivers Ship Mail at Sea

OCEAN travelers on the S.S. *Adriatic*, the sailing of which on August 15th marked the reopening of the White Star Line's service to Cherbourg and Southampton, witnest the successful attempt of the Post Office Department to use aircraft for the first time in delivering European mail to a steamer. Congratulatory messages were sent by passengers to Postmaster Thomas G. Patten and officials of the Acromarine Plane and Motor Corporation, who were responsible for the demonstration.

The hydroaeroplane, piloted by C. J. Zimmerman with Richard Geisinger as mechanic, left the surface of the Hudson River off Eighty-sixth Street, New York, at 1:30 P. M., an hour and a half after the Adriatic had sailed. Before the mail pouch was placed on board the plane Zimmerman, the pilot, was sworn in by Daniel E. Jordan, Assistant Superintendent of Mail, as an employe of the Post Office Department.

Overtaking the Adriatic at Ambrose Channel the plane flew for a distance ahead of the steamer and then, turning around, flew directly toward her. As the plane past over the Adriatic at a height of about 50 feet above masthead, a specially devised weighted cable with shock absorbers was released, catching and wrapping itself around a cable which ran from the masthead to the deck, as shown in the accompanying illustration. The mail pouch, which was contained in a pocket constructed of laminated wood on the forward right fuselage, was pulled out when the cable contracted, dropping into the water. The pouch, also specially constructed to insure its being waterproof, was then hauled on board.

The achievement was witnest by Postmaster Patten, Inglis M. Uppercu, President of the Aeromarine Plane and Motor Corporation, and a party of guests who went down the bay on the yacht *Lounger*. The passengers on the steamer cheered as the seaplane glided away.



The Latest Mail Carrier—the "Seaplane." A Seaplane Successfully Delivered Mail to the S.S. Adriatic When She was a Considerable Distance at Sea, thus Demonstrating How the "Mail Time" Between America and Europe can Be Greatly Shortened.

My Inventions

By Nikola Tesla

VI. THE ART OF TELAUTOMATICS

How Tesla's Mind Recuperates.

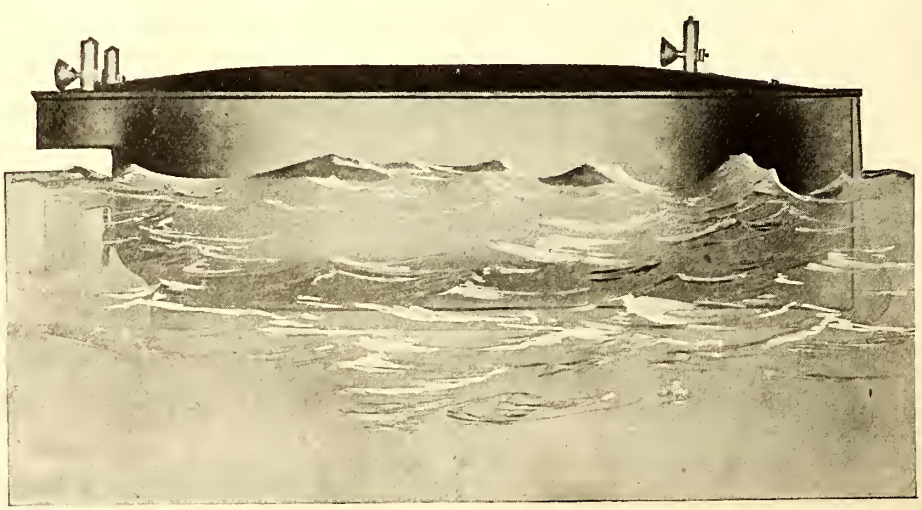
NO subject to which I have ever devoted myself has called for such concentration of mind and strained to so dangerous a degree the finest fibers of my brain as the system of which the Magnifying Transmitter is the foundation. I put all the intensity and vigor of youth in the development of the rotating field discoveries, but those early labors were of a different character. Although strenuous in the extreme, they did not involve that keen and exhausting discernment which had to be exercised in attacking the many puzzling problems of the wireless. Despite my rare physical endurance at that period the abused nerves finally rebelled and I suffered a complete collapse, just as the consummation of the long and difficult task was almost in sight. Without doubt I would have paid a greater penalty later, and very likely my career would have been prematurely terminated, had not providence equipt me with a safety device, which has seemed to improve with advancing years and unfailingly comes into play when my forces are at an end. So long as it operates I am safe from danger, due to overwork, which threatens other inventors and, incidentally, I need no vacations which are indispensable to most people. When I am all but used up I simply do as the darkies, who "naturally fall asleep while white folks worry." To venture a theory out of my sphere—the body probably accumulates little by little a definite quantity of some toxic agent and I sink into a nearly lethargic state which lasts half an hour to the minute. Upon awakening I have the sensation as though the events immediately preceding had occurred very long ago, and if I attempt to continue the interrupted train of thought I feel a veritable mental nausea. Involuntarily I then turn to other work and am surprised at the freshness of the mind and ease with which I overcome obstacles that had baffled me before. After weeks or months my passion for the temporarily abandoned invention returns and I invariably find answers to all the vexing questions with scarcely any effort. In this connection I will tell of an extraordinary experience which may be of interest to students of psychology. I had produced a striking phenomenon with my grounded transmitter and was endeavoring to ascertain its true significance in relation to the currents propagated through the earth. It seemed a hopeless undertaking, and for more than a year I worked unremittingly, but in vain. This profound study so entirely absorbed me that I became forgetful of everything else, even of my undermined health. At last, as I was at the point of breaking down, nature applied the preservative inducing lethal sleep. Regaining my senses, I realized with consternation that I was unable to visualize scenes from my life except those of infancy, the very first ones that had entered my consciousness. Curiously enough, these appeared before my vision with startling distinctness and afforded me welcome relief. Night after night, when retiring, I would think of them and more and more of my previous existence was revealed. The image of my mother was always the principal figure in the spectacle that slowly unfolded, and a consuming desire to see her again gradually took possession of me. This feeling grew so strong that I resolved to drop all work and satisfy my longing. But I found it too hard to break away from the laboratory, and several months elapsed during which I had succeeded in reviving all the impressions of my past life up to the spring of 1892. In the next picture that came out of the mist of oblivion, I saw myself at the *Hotel de la Paix* in Paris just coming to from one of my peculiar sleeping spells, which had been caused by prolonged exertion of the brain. Imagine the pain and distress I felt when it flashed upon my mind that a dispatch was handed to me at that very moment bearing the sad news that my mother was dying; I remembered how I made the long journey home without an hour of rest and how she passed away after weeks of agony! It was especially remarkable that during all this period of partially obliterated memory I was fully

IN this article, Dr. Tesla dwells on the future possibilities of his magnifying transmitter, especially in connection with the art of Telautomatics, which was first conceived by him and doubtless constitutes one of his most brilliant gifts to the world.

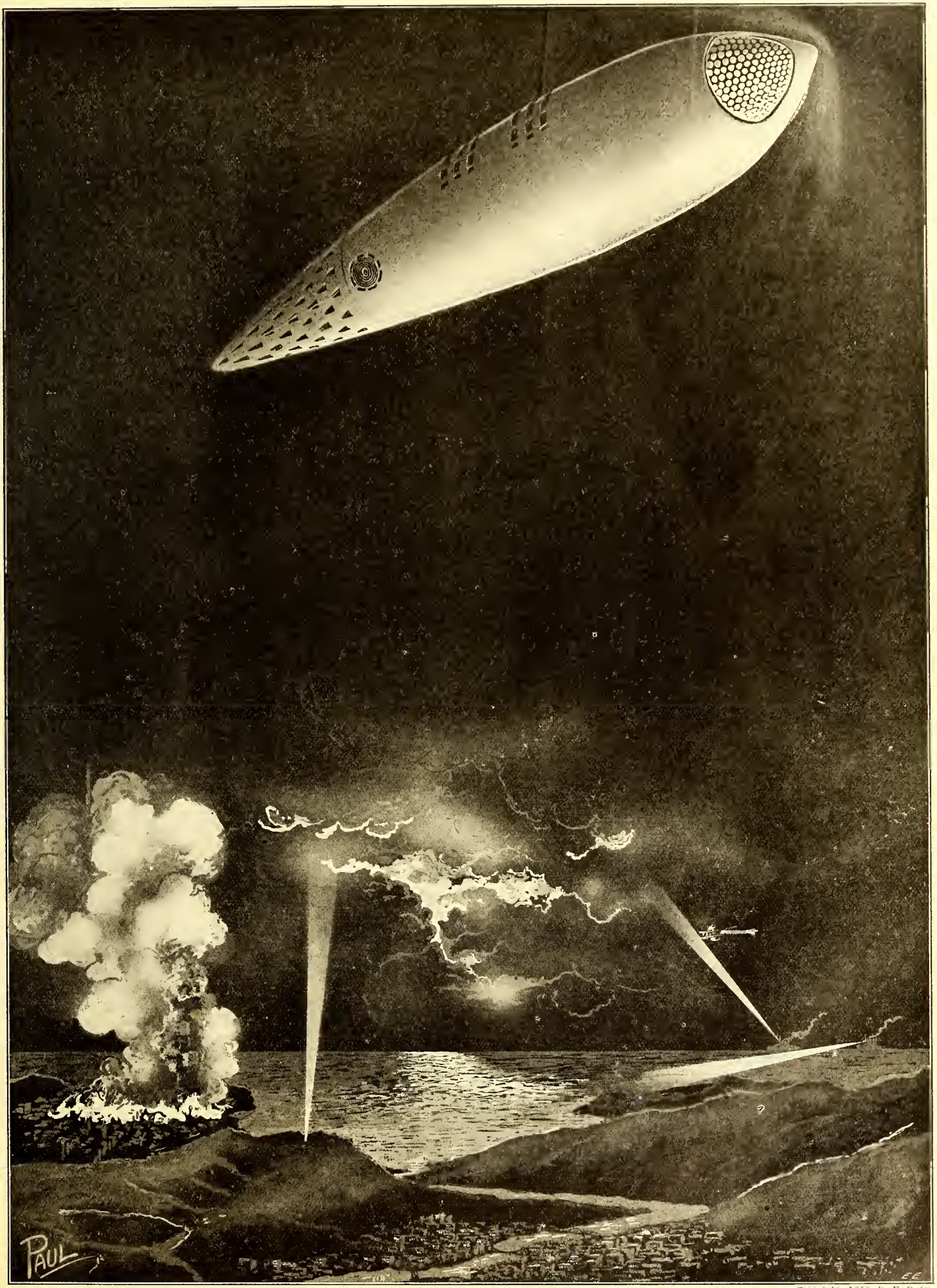
Tesla was the first to build and successfully operate Automata in the form of boats steered and otherwise controlled by tuned wireless circuits and agents ensuring reliable action despite of all attempts to interfere.

But this was only the first step in the evolution of his invention. What he wanted, was to produce machines capable of acting as though possessed of intelligence. It will be readily perceived that if Dr. Tesla has practically realized his conception, the world will witness a revolution in every field of endeavor. In particular will his inventions affect the art of warfare and the peace of the world.

Dr. Tesla dwells eloquently on a number of topics agitating the public mind, and this article of his is perhaps the most brilliant and absorbing he has written.



One of the Telautomatic Boats (Submersible) Constructed By Tesla and Exhibited By Him in 1898. Controlled By Wireless Without Aerials.



Tesla's New Self-Propelled Aerial Tel-Automaton. Devoid of Propeller, Sustaining Wings and All Other Means of External Control. Can Attain a Speed of 350 Miles Per Hour, and Will Reach a Predetermined Point a Thousand Miles Away Accurately Within a Few Feet.

alive to everything touching on the subject of my research. I could recall the smallest details and the least insignificant observations in my experiments and even recite pages of text and complex mathematical formulae.

My belief is firm in a law of compensation. The true rewards are ever in proportion to the labor and sacrifices made. This is one of the reasons why I feel certain that of all my inventions, the Magnifying Transmitter will prove most important and valuable to future generations. I am prompted to this prediction not so much by thoughts of the commercial and industrial revolution which it will surely bring about, but of the humanitarian consequences of the many achievements it makes possible. Considerations of mere utility weigh little in the balance against the higher benefits of civilization. We are confronted with portentous problems which can not be solved just by providing for our material existence, however abundantly. On the contrary, progress in this direction is fraught with hazards and perils not less menacing than those born from want and suffering. If we were to release the energy of atoms or discover some other way of developing cheap and unlimited power at any point of the globe this accomplishment, instead of being a blessing, might bring disaster to mankind in giving rise to dissension and anarchy which would ultimately result in the enthronement of the hated regime of force. The greatest good will come from technical improvements tending to unification and harmony, and my wireless transmitter is preeminently such. By its means the human voice and likeness will be reproduced everywhere and factories driven thousands of miles from waterfalls furnishing the power; aerial machines will be propelled around the earth without a stop and the sun's energy controlled to create lakes and rivers for motive purposes and transformation of arid deserts into fertile land. Its introduction for telegraphic, telephonic and similar uses will automatically cut out the statics and all other interferences which at present impose narrow limits to the application of the wireless. This is a timely topic on which a few words might not be amiss.

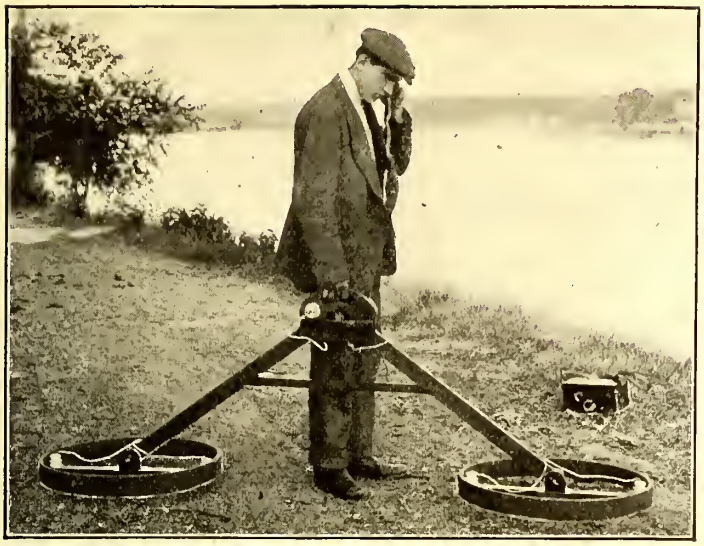
Dr. Tesla is Rapidly Becoming Younger. Judge for Yourself from His Latest Photograph.

Tesla Raps "Static" Men Vigorously.

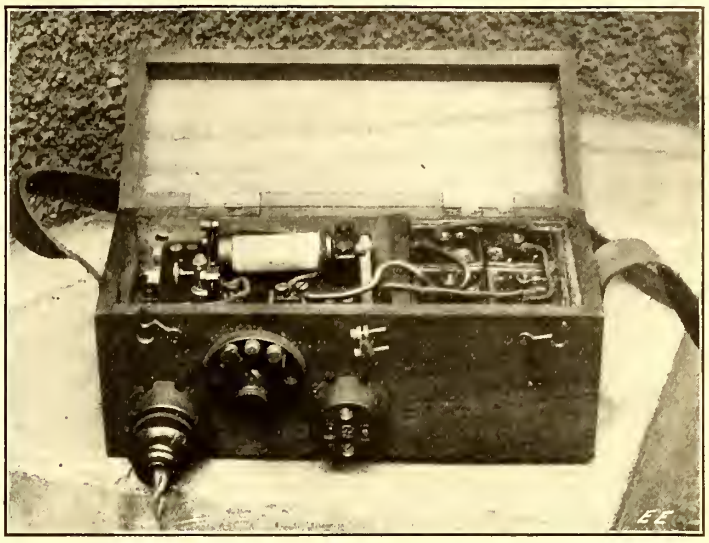
During the past decade a number of people have arrogantly claimed that they had succeeded in doing away with this impediment. I have carefully examined all of the arrangements described and tested most of them long before they were publicly disclosed, but the finding was uniformly negative. A recent official statement from the U. S. Navy may, perhaps, have taught some beguilable news editors how to appraise these announcements at their real worth. As a rule the attempts are based on theories so fallacious that whenever they come to my notice I can not help thinking in a lighter vein. Quite recently a new discovery was heralded, with a deafening flourish of trumpets, but it proved another case of a mountain bringing forth a mouse. This reminds me of an exciting incident which took place years ago when I was conducting my experiments with currents of high frequency. Steve Brodie had just jumped off the Brooklyn Bridge. The feat has been vulgarized since by imitators, but the first report electrified New York. I was very impressionable then and frequently spoke of the daring printer. On a hot afternoon I felt the necessity of refreshing myself and stepped into one of the popular thirty thousand institutions of this great city where a delicious twelve per cent beverage was served which can now be had only by making a trip to the poor and devastated countries of Europe. The attendance was large and not over-distinguished and a matter was discussed which gave me an admirable opening for the careless remark: "This is what I said when I jumped off the bridge." No sooner had I uttered these words than I felt like the companion of Timotheus in the poem of Schiller. In an instant there was a pandemonium and a dozen voices cried: "It is Brodie!" I threw a quarter on the counter and bolted for the door but the crowd was at my heels with yells: "Stop, Steve!" which must have been misunderstood for many persons tried to hold me up as I ran frantically for my haven of refuge. By darting around corners I fortunately managed—through the medium of a fire-escape—to reach the laboratory, where I threw off my coat, camouflaged myself as a hard-working blacksmith, and started the forge. But these precautions proved unnecessary; I had eluded my pursuers. For many years afterward, at night, when imagination turns into spectres the trifling troubles of the day, I often thought, as I tossed on the bed, what my fate would have been had that mob caught me and found out that I was not Steve Brodie!

Now the engineer, who lately gave an account before a technical body of a novel remedy against statics based on a "heretofore unknown law of nature," seems to have been as reckless as myself when he contended that these disturbances propagate up and down, while those of a transmitter proceed along the earth. It would mean that a condenser, as this globe, with its gaseous envelope, could be charged and discharged in a manner quite contrary to the fundamental teachings propounded in every elemental text-book of physics. Such a supposition would have been condemned as erroneous, even in Franklin's time, for the facts bearing on this were then well known and the identity between atmospheric electricity and that developed by machines was fully established. Obviously, natural and artificial disturbances propagate through the earth and the air in exactly the same way, and both set up electro-motive forces in the horizontal, as well as vertical, sense. Interference can not be overcome by any such methods as were proposed. The truth is this: In the air the potential increases at the rate of about fifty volts per foot of elevation, owing to which there may be a difference of pressure amounting to twenty, or even forty thousand volts between the upper and lower ends of the antenna. The masses of the charged atmosphere are constantly in motion and give up electricity to the conductor, not continuously but rather disruptively, this producing a grinding noise in a sensitive telephonic

(*Continued on page* 550)



This New French Inductive Water Pipe Locater Can Be Used by Either One or Two Men.



A Close-up of the "Chanoit" Electric Water Pipe Locating Apparatus. A Battery and Induction Coil Are Used.

Paris Letter

By JACQUES BOYER
Paris Correspondent "Electrical Experimenter."

ENGINEER CHANOIT has conceived the idea of using a new electrical induction balance invented during the war by Prof. Gutton for the location of non-exploded shells, to locate underground water terminals of the waterpipe distribution system.

The new apparatus is a little different in form, but the principle is the same. This induction balance "Alpha" (Model 1919) consists of two flat coils mounted in series in the same circuit, and in which alternating current induces currents in two neighboring coils. In these coils the wire is wound in such a way that the electromotive forces are reversed every instant. The coils measure 70 centimeters in diameter; the wire is wound at the rate of 20 turns on the primary and only 10 turns on the secondary. As to the armature, sieve chassis are used. A wooden traverse mounted across the diameter insures the rigidity of these drums, covered by a rubber tissue to protect the wire wound on the same. Attached to the traverses are two wooden uprights mounted at an angle toward each other, and supporting at their junction a special regulating system.

Induction Balance Locates Water Pipes

If both pair of coils are exactly identical, the electro-motive forces would be compensated and a telephone connected in circuit would remain silent. But in view of the impossibility of obtaining a perfect similarity between these two pair of coils, a variable inductive regulator is added, enabling the neutralization of the mutual induction of the two primary and secondary circuits. All that is necessary is to mount in each of the circuits a small coil with four turns of wire, which is illustrated in the photograph herewith, in the center of the instrument underneath the handle; one of these coils moving inside, the other around the common center. This rotation in modifying the mutual induction of the two circuits, permits the regulation of the "Alpha" balance instrument at the moment of use.

When a mass of iron is in the neighborhood of one of the pair of coils, it creates an asymmetry which wards off the compensation. The 'phone will then give forth a sound. Moreover, in a portable box there is mounted with a condenser a battery of four cells, or a storage battery, which excites a vibrator. The electro-motive forces of self-induction in the coil of the vibrator, charge and discharge the condenser periodically, realizing in this manner the primary excitation.

When the employees of the Water Department want to proceed, they attach the apparatus to their backs, mount their bicycles, and ride toward the pipe line which they want to explore. Once upon the grounds, they mount the apparatus and connect the wires. Usually two work together, but one man alone can do the work satisfactorily. If working in pairs, the observer goes along the road with the balance, holding the same at a little distance over the ground, his assistant following with the box containing the battery, condenser and vibrator. If working alone, the man puts his box on the ground and moves it as he goes along. When passing over a buried waterpipe up to a depth of one yard, the 'phone will indicate by its characteristic buzz the exact location of the same.

New Hospital Call Switch

Most modern hospitals are equipt with *hospital call systems*, which, in many instances give fairly satisfactory service, but one trouble often arises from their use because a great majority of them employ some form of standard electrical device which the patient uses to signal the nurse. The device usually consists of a pendant type of push button fastened to a flexible conductor which is hung over the head of the bed. These standard wiring devices are not intended for such service, and there is considerable wear and tear on the cord, and as a result the cord frequently becomes worn, thus making the signal inoperative.

A new device called a Hospital Call Switch has just been developed. It is made for a standard switch outlet box, and the wiring for it does not extend beyond the box. No flexible conductors or pendant switches are required for its use, and consequently, the annoyance of having these parts worn or broken is eliminated. It is so constructed that the patient can only complete the circuit to signal the nurse, and she can push it "off" only at the bed-side.

A New Hospital Call Switch. Individual Indication At Each Bed Is Effected. The Nurse Cannot Ignore It.

The accompanying illustration shows one of these new switches installed in the wall near the patient's bed. A pull chain, to which a linen cord is attached, is used to pull the switch "on." The push-button, located above the horn, thru which the pull chain extends, is used by the nurse to push the switch "off." In a ward, where two or more switches are used on the same signal, the protruding button indicates to the nurse which patient called. The signal remains "on," therefore, until the nurse comes to the bed to push the switch "off." Hence there is no excuse for the patient's call not being observed and answered.

What the X-Rays Show

Scientific and Industrial Applications of X-Rays in War and Peace

THE X-ray to most of us conjures up visions of white robed nurses, surgeons, and hospital operating rooms. But today the X-ray, discovered by Wilhelm Conrad Röntgen in 1895, gives promise of becoming one of the world's greatest and most useful accomplishments. No longer is the X-ray confined alone to hospital and physicians' diagnostic requirements, but it has been used in the past few years, especially during the World War, for many hitherto undreamt of purposes. In fact, one could write a book on the industrial applications of X-rays which would read like a romance. How they helped to foil the German conspirators in America who tried to plant infernal machines and contraband rubber and nickel into bales of cotton; how steel needles and other metal objects were actually placed into bags of powder in U. S. Government arsenals by pro-German workers; how defects were allowed to pass in shells, other ammunition and guns, and dozens of other dangerous practices, as well as interesting scientific developments —all of these are a matter of history now.

Figure 1 of the accompanying illustrations shows a large X-ray machine being used to detect the presence of contraband rubber or metal placed in bales of cotton. A number of these X-ray machines were used at the leading cotton shipping ports of the South during the war. Infernal machines timed to go off at sea were often detected in this way, altho little or nothing was ever said about these discoveries for very good reasons. If these discoveries on the part of Uncle Sam's secret service and shipping experts had been made public at the time, naturally the perpetrators of such crimes would have directed their energies to other ways and means of attaining their objects.

More romantic perhaps is the application of the X-ray for discovering the presence of pearls or the nuclei of pearls starting to grow in oysters. Figure 2 shows the X-ray apparatus in use for this purpose. Previously, many thousands of oysters were annually obliterated by being opened in an effort to determine the presence of pearls or pearl nuclei. All of this is now obviated, thanks to the X-ray, and if Mr. Oyster does not show up with a pearl nuclei, he is replanted in his natural habitat, the water, once more. Here it develops to maturity. If an undeveloped pearl is detected by the X-ray pearl expert, then the oyster is at once laid aside for further treatment.

Bullets and shell have been examined by thousands, as shown in Figure 3, by powerful X-rays. The X-ray in this case shows the amount of powder in the shell, how it is loaded, et cetera, and the same is true also for bullets. A different shadow is cast on the X-ray plate or fluoroscope for each different material, so that differentiation between each substance is readily possible. Defects in the loading and assembling of shell were frequently detected in this way at the great shell factories and arsenals during the war, thus preventing misfires and premature explosions, with a possible large loss of life.

Concrete ships have been rapidly coming to the fore in the past few years, and were developed to quite a large extent during the war, many being built in this country and abroad. No matter how expert the inspectors on such hulls may be, they cannot tell in any case how the interior of the concrete structure looks, especially the steel reinforcement bars, which may have become bent or misplaced during the pouring process.

Figure 4 gives an idea of how valuable the special portable X-ray outfits prove in finally checking up the hulls of such vessels before they are launched. A bent or misplaced steel reinforcement or an air-pocket, either of which would constitute a serious altho unnoticeable weakness in the hull, can be quickly detected by the X-ray. For such large area X-ray examinations a fluoroscope is invariably used, and not the photographic plate.

How many railroad accidents have been caused by defective car wheels? Many of them, if the truth were known. And why is this? Simply because the iron wheels appeared to be all right, and withstood possibly a fair mechanical test, but inherently they possest a weakness, perhaps in the form of air pockets or invisible cracks caused by strains in cooling when they were cast, etc., etc.—defects which only the X-ray can and does detect at once in a minimum of time.

For such purposes an X-ray is used in the manner here illustrated at Figure 5. The X-ray tube together with exciting spark coil, batteries, et cetera, are placed in a portable carrying case, which can be placed behind the car wheel or other object. The fluoroscope, or, in special places, the X-ray plate in its light-proof holder, is placed before the car wheel or other object. A few seconds' exposure to the X-ray gives a *skiagraph* or X-ray photograph on the plate, which is afterward developed and printed, or the image may be, and usually is, examined on the negative itself, no print being made. Of course, if the fluoroscope is used for directly viewing the object under examination, then the object is seen clearly at once, and various parts of it examined by moving the fluoroscope over the surface.

Many lives have been lost due to the explosion of anarchists' bombs and infernal machines, not only when they happened to explode in locations where they were *planted,* but also when they have been under the process of examination by bomb experts of various city police departments. The examination of bombs and infernal machines now bids fair to presently become as concrete and specific a procedure as weighing a pound of coal. The X-ray has already been used with marked success in determining the structure of such dangerous devices beforehand, which is of course a great stride in advance of the erstwhile method of "yanking" the bomb apart and "waiting to see what would happen." See Figure 6.

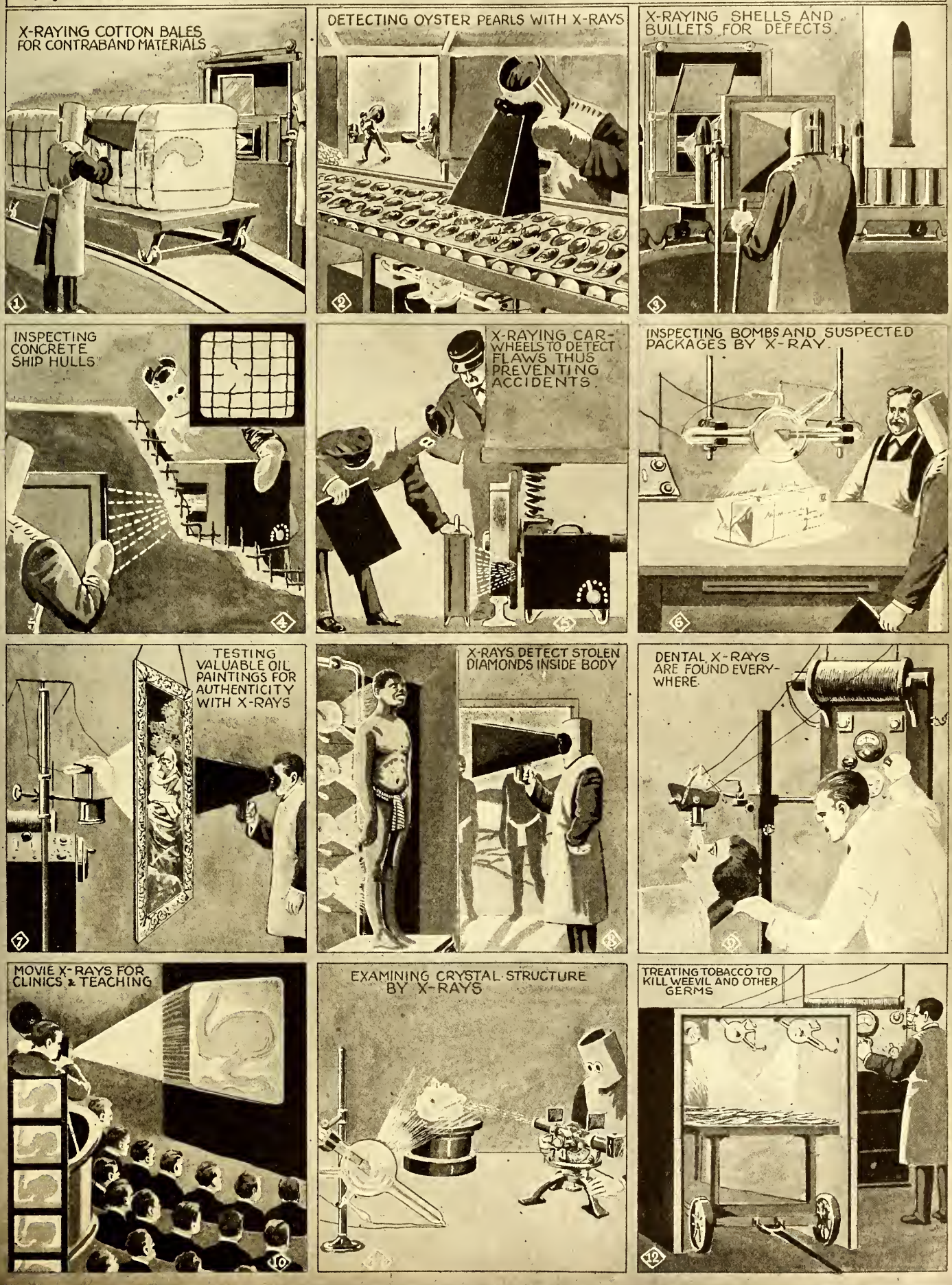
Even the field of Art, including cubist paintings, has been invaded by the mechanistic X-ray tube with its prying eyes, the discerning powers of which will not be denied. To the Scientist and his X-ray tube must come the Artist or the Art Connoisseur with his ancient and almost priceless Rembrandt, Van Dyke, Corot or Blakelock, the *authenticity* of which may be in question. A number of notable forgeries in supposedly valuable paintings have been detected by the scrutinizing X-ray. Figure 7 shows the X-ray being used to determine the authenticity of old paintings.

Another fruitful field in which the X-ray has proven its value many times is in the examination of large diamonds and other precious stones. Instead of X-raying the diamond to determine its value as a diamond, another application in this same field lies in its use at one of the large South African diamond mines for the purpose of detecting the presence of a diamond within the body. This may sound somewhat startling at first, but there have been cases where diamond miners have even "swallowed" diamonds in order to smuggle them out of the mines. Therefore, at this particular mine all of the miners undergo an X-ray examination, as shown in the accompanying illustration, Figure 8, before they leave the mine at the end of the day's work.

The modern Dentist has found that the X-ray is the only means whereby he can be sure that he is properly diagnosing the ailment of his patient. As pointed out in an exhaustive article by Dr. Henry A. Cotton, Medical Director of the New Jersey State Hospital, Trenton, N. J., in the August issue of this journal, defective teeth are sometimes due to *abscesses* and other growths forming at the roots, whch are not visible in any other way by physical examination, except by the X-ray. Such abscesses are the cause of serious organic and systemic disorders and ailments, such as rheumatism, neuralgia, stomach and intestinal troubles, and many other ills which would

(*Continued on page* 603)

WHAT THE X-RAYS SHOW



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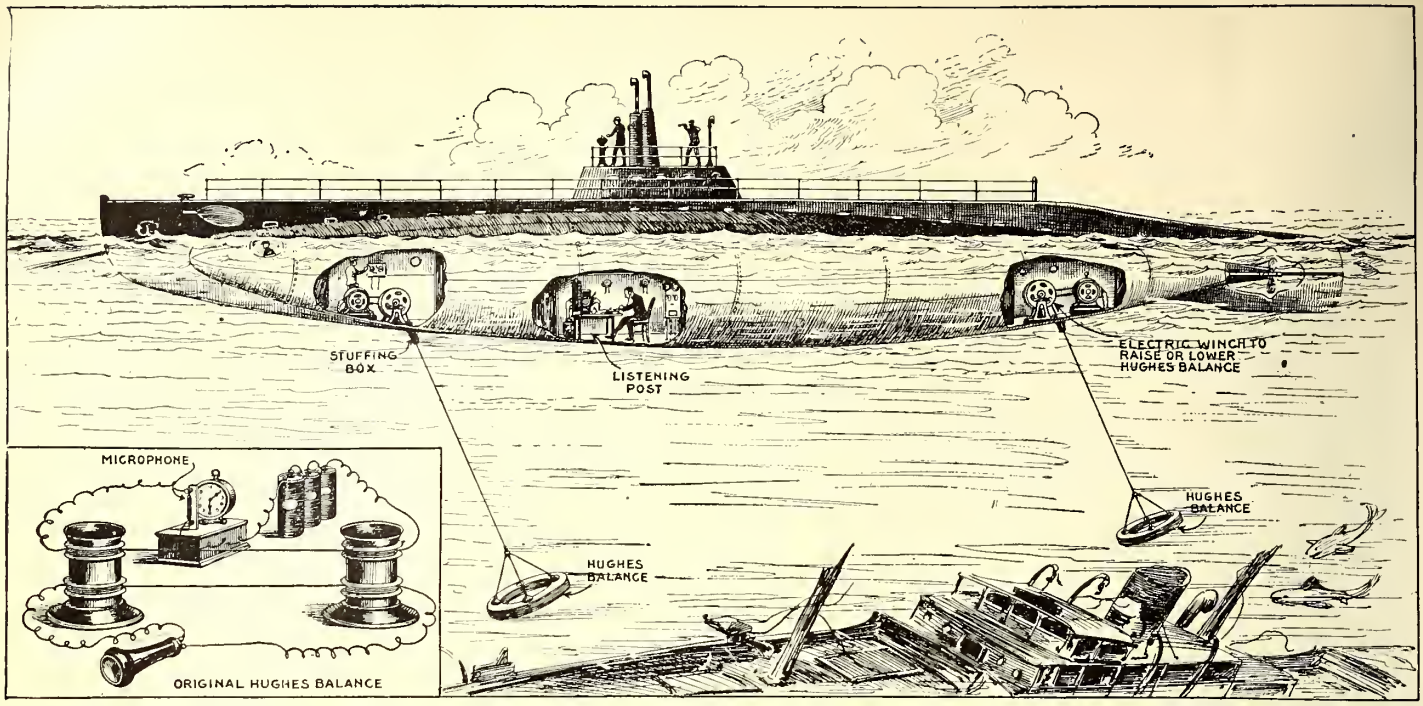

As Our Front Cover Illustration Shows, this New Invention for Locating Sunken Ships Can Be Operated Without the Aid of Divers or Diving Machines. It is Based on the Hughes Induction Balance, Where a Slight Change in the Induction Between Four Balanced Coils Causes a Sound to Be Heard in One of the Circuits.

Treasure Ships Located Electrically

By H. GERNSBACK

THE salvage of 440 vessels and the recovery of property valued at $250,000,000 is the record in four years of the British Admiralty Department, which under Rear-Admiral Philpotts has been conducting salvage operations in home and foreign waters.

Thus reads a recent newspaper clipping. But the $250,000,000 worth of property recovered represents only a very small percentage of the ships that had been sunk during the present war as well as during the past century.

The ocean is dotted with sunken ships containing such fabulous treasures that it is difficult for the mind to grasp the enormous figures. It runs way up into the billions, and while we do not pretend to claim that all of this property, even if recovered, would be of value, there still remain many billions' worth of sunken treasures which can be salvaged today.

When a ship with a cargo sinks, that cargo is not always valuable if recovered. For instance, it might have had on board grain or other perishable goods, which, even if salvaged, would be found useless. But many other ships containing mixed cargoes, such as metal, coal, bullion, certain chemicals, etc., do not deteriorate even if they have been on the bottom of the ocean for years, and the great majority of sunken ships contain at least a large part of their cargo, which is quite imperishable.

Then, too, if a vessel is raised within one or two years after it has been sunk, it can in many cases be refitted and will do service just as good as new, after it has been overhauled. Here the ship whose intrinsic value is quite high is well worth salvaging, if there is a possibility of us doing so.

The main trouble in the past has not been so much in actually salvaging the ship, but in *accurately locating it* so that divers or the diving apparatus can be brought into action. It is one thing to know the *approximate* position where a ship has been sunk, but it is quite another matter to know the *exact spot*. In other words, tho we have a chart which gives the spot on which a ship has been sunk, *this spot may measure five square miles or more,* and if the ship is located in any channel or such parts of the ocean where there are heavy undercurrents, such a ship will soon be covered over with sand, moss, barnacles, etc., which effectively hide the ship and make it very difficult for the divers to locate it.

Many a salvaging company has found to its regret that it is one thing to obtain a commission to raise a sunken ship and quite another to actually locate it in order to start the salvaging operation. How then are ships located?

We have several means at hand. One of the simplest is to send down divers, using powerful under-water searchlights, and then make a systematic search in order to find the wreck. This is not only a lengthy and difficult procedure, but when the ship lies at a great depth the high water pressure makes it impossible for the divers to reach the bottom.

The next method is to use grappling irons or anchors, which may be termed the "fishing" method. This, perhaps, is the least satisfactory as it takes a long time and does not always bring results. It is at most a long and weary procedure, and very expensive on account of the enormous time losses involved.

We still have another method which, while not new, is not known as well as it deserves. It is a purely electrical method in locating sunken ships. It is very efficient, and the cost is negligible as long as we own a ship or a submarine on which to install the apparatus. The writer advances the idea of using the submarine in a peaceful mission to raise the ships wantonly sunk by its war sisters during the world war.

In order to detect the sunken hulls, use is made of the induction balance invented by Hughes in 1881. The insert in our illustration on this page shows the basic principle of the apparatus. Two wooden or hard rubber cups about four inches high and one and a quarter inches in diameter are turned out. Upon each of these cups we now wind 150 yards of single silk copper wire No. 32, which gives us a spool about a quarter of an inch high. Each wooden cup has two such windings, as will be noted from the illustration. These two wooden cups now form the pans of the thus constructed induction balance. The connections are made as in the illustration; the two lower windings connecting with an ordinary telephone receiver, while the other two spools are in series with a microphone and three dry cells. We now have an instrument of extraordinary sensitivity. In the position shown in the illustration, if you pick up the telephone receiver no sound is heard because the two parts of the balance are in equilibrium. If, however, we drop into one of the cups a piece of metal, no matter how small, the electrical compensation will be disrupted, due to the difference of resistance thus created, and we now hear the clock ticking in the telephone.

This instrument is so extraordinarily sensitive that even if two equal coins are dropt, one in each cup, the telephone will sound just the same because these two coins are not *exactly* of the same weight nor of the same alloy. The slightest chemical difference will thus be shown in the induction balance. For that reason this instrument has been used a good deal for exploration work, and the idea to use the induction balance for finding sunken vessels is by no means a new one. It has been used successfully for a number of years.

Our illustration shows how it is accomplished. If we fit out a submarine as shown, which has two induction balances lowered into the water and which are trailed from underneath, the telephone receiver on board located in the control station will give forth no sound as long as the two balances move thru the water. But the minute one of them comes within the vicinity of a wreck, say within five hundred feet or more, the electrical balance will be disturbed immediately, and the telephone will sound its warning to the operator. The nearer the balance comes to the wreck the louder the sound will be. It is thus a

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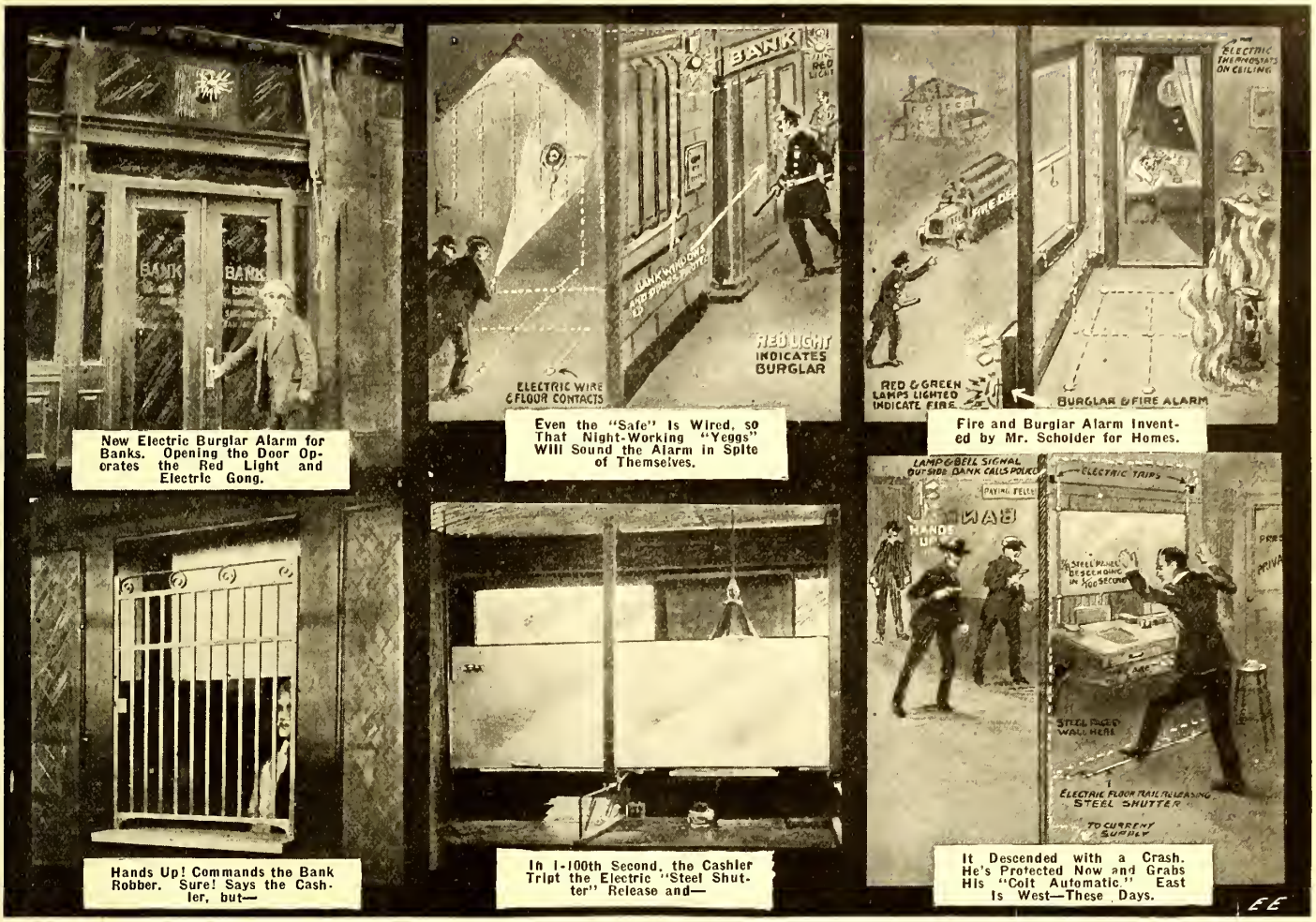

Electricity Foils Bank Robbers

BANK robberies being so prevalent at the present day induced a very ingenious inventor, Mr. Scholder, of New York, to try out a new invention after he had had it patented. In the Bronx, New York, there is a small bank, entirely too small for the business it is doing, which decided that the only way to safeguard itself, its employees and its patrons was to install an electric Burglar Alarm, which would not have the disadvantages of other alarms, and at the same time work more efficiently than any such device yet perfected. Accordingly a contract was given to the inventor, and the device was promptly installed. A demonstration showed its utmost reliability in every respect. The device is now installed in the Cosmopolitan Bank, Prospect Avenue, Bronx.

It consists of various applications of alarm and signaling systems, original and patented by the inventor. Should a burglar attempt to enter the bank, an alarm is immediately sounded in the form of a large gong and a red lamp flashes; this lamp is so protected outside of the bank that neither the gong nor the flashers can be tampered with, as shown in the photographs. The gong is enclosed in a perforated steel box, of which there are four, one at either entrance of the bank, one in the basement and one in the bank proper. Should one of the gongs thru any chance be destroyed, the other three gongs will immediately set up an alarm, reinforced by the red light flashes, which attract passers-by or any policeman on beat. A special novelty of this protective system is that installed at the tellers' windows. These are equipt with steel drops ⅛" thick, which are held in place by electric latches, one at each end, the drops running the entire length of the window and high enough to protect those behind from any trouble or misfortune. Should any system of robbery such as has been tried in other banks be attempted here, and the robber enter, levelling his gun with a cry of "Hands Up!" a *slight* foot movement on the part of the teller will immediately release the drop with a terrific bang, as this steel curtain (which effectively protects him from being shot) drops down. Immediately, both inside and out, alarms and electrical flashes announce the hold-up, preventing the killing, accidentally or purposely, of any of the employees and the loss of property as well. The bank is so protected that no burglar can enter the premises thru doors, windows or any other opening; even should he attempt to tunnel into the bank and tear a portion of the wall down, he would be instantly detected. As far as safes and safety vaults are concerned, it is impossible for even an experienced safecracker to touch anything from the inside, whether the outside door is opened by knowing its combination, or by dynamiting the safe, inasmuch as an insert of the safe consisting of a fiber frame, lined with web-like wires, will cause an instant alarm.

Now a word about the device. This consists of a double contact or 2-way relay, which will prevent either cutting, short-circuiting or interference in any way with the wires, this relay actuating an automatic drop. This drop is connected with flashers and well-concealed wires running to the bell and lights, so that any attempt to cut or destroy the signaling devices will set off the alarms in other parts of the building and at other exits. The bank is thoroly wired, and an attempt of breaking thru the walls would be immediately frustrated. Thermostatic fire alarms thruout the building are arranged in a like manner, and wired to a distinct annunciator, which warns of any conflagration by means of the intermittent or continuous bell alarm, and flashes of both red and green lights, the two together indicating *fire,* and the red alone indicating burglary. The approach to the safe itself is thoroly wired. The alarm can be arranged in such a way as to notify the Police Headquarters, at the same time attracting the attention of all those about. The writer has seen an actual demonstration of the device, and in which attempts were made to force open the door. Another scene demonstrating the "hands-up" attempt to make the teller "fork over" met the response on the part of the teller by a prompt lifting up of his hands. Immediately a steel curtain dropt down with a terrific crash (in about 1/100 second), hiding the teller from view and protecting him from all harm. The release of the curtain, together with the crash and alarm is enough to scare any yeggman, no matter how bold he may be.

To Europe in Three Hours

By H. WINFIELD SECOR

ASSOCIATE MEMBER AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The Physics of the Upper Atmosphere. How High Can We Fly and Why?

SEVERAL attempts have recently been made to improve on the high altitude flight records, the highest point so far reached being that attained by the French flier, Adjutant Casale, who unofficially reached a height of 33,136 feet. A few weeks ago Mr. Roland Rohlfs, chief test pilot for the Curtiss Engineering Corporation, established a new official altitude record at Mineola, L. I., N. Y., when he soared to a height of nearly 31,000 feet (30,700 feet Unhomologated). Some of the experiences of Mr. Rohlfs, as well as those of Major R. W. Schroeder, A. S. A., who held the best previous American altitude record of 28,900 feet, made on September 18th, 1918, are given elsewhere in this article.

AIR PRESSURE RAPIDLY DECREASES AT HIGH ALTITUDES

It is undoubtedly a common belief that the only requisites necessary in ascending to a great height in an airplane are great stamina and a one hundred per cent physique on the part of the flier, a good plane and engine and devices arranged so as to overcome the effects of the severe cold felt at the higher altitudes, such as 25,000 to 30,000 feet. There are many other factors, however, which come to bear on this important matter of flight in the upper rarefied air strata, one of the most important of which is the rapid reduction in the atmospheric pressure on the body at such altitudes as 30,000 feet and above. Before going further, it should be said that there naturally must be a limit to the permissible reduction of this air pressure in order to live. If we reduce this pressure to a very small fraction of the normal pressure at sea level, which is 14.72 pounds for every square inch of the body surface, then it becomes evident that the pressure of the blood as it is pumped thru the veins by the heart will burst them. If a frog is placed under a glass bell and the air exhausted, the frog will blow to pieces, due possibly for one reason to the air trapt in the lungs, which bursts these tissues when the external pressure is removed from the body, and due to a second and very important reason—that so long as the heart keeps pumping the blood thru the veins of the body this pressure, which is considerable indeed, will cause these vessels to burst. Persons often ask, "How high will our birdmen, with every possible airplane refinement, be able to fly, and if, generally speaking, there is no limit, provided planes and engines can be built which will operate properly in the upper rarefied air strata?" The answer is—that there is certainly and most decidedly a "limit," and we would state here that it is our belief that unless specially arranged engines and carburetor systems, fitted with the new atmospheric compressor and enclosed cabs, possibly *vacuum bottle* cabs, to protect the crew are used, then when flying in an ordinary machine where he will have to breathe the air direct from the atmosphere (even with the aid of oxygen), he cannot hope to ascend to a greater height than 38,000 to 40,000 feet.

The author became particularly interested in this matter and went to the trouble of taking up this subject with the New York branch of the U. S. Weather Bureau, and desires here to give thanks to the courtesy of Mr. J. H. Kimball of that Bureau, who kindly looked up records on some wonderful pilot balloon tests and observations made by the U. S. Weather Bureau Service. Figures for the air pressure and temperature at various altitudes are presented in the illustration herewith, where some interesting speed figures are given for various types of aircraft as well as steamships. It is interesting to note at this juncture that the amount of increased speed for the future is all with the airplane or dirigible—and *not* with the ocean-going steamship. Ocean-going steamships have about reached their highest speed, due to several engineering reasons. Such a vessel displaces constantly a very large amount of water, and the laws governing this are very well known, and have been worked out by technicians to a very high degree in the past ten to fifteen years. It is doubtful if we shall ever see a steamship which can cross the ocean in a shorter time than *three days*, unless an unreasonably large amount of horse-power is consumed for the purpose, which, of course, is diametrically opposed to the high efficiency standards demanded of all such transportation carriers today.

The airship, on the other hand, has the advantage that as it ascends to higher altitudes it meets with less resistance, and not only this, but another wonderful phenomenon of nature occurs—the higher air strata are known, as tests have shown, to be moving at a very high velocity, and so it is readily seen that if an airplane ascends to an altitude of 20,000 to 30,000 feet, or even less, that it may strike a strata of air traveling eastward, or perhaps westward, having a velocity of 200 miles an hour or more. Hence, if the airplane can travel at 100 miles an hour, then its net velocity in a given direction will be 300 miles an hour!

It is believed that the successful pioneer transatlantic flight of Messrs. Alcock and Brown, totaling 1,880 miles, which was made in sixteen hours, at an average speed of 116 miles an hour, was due to the fact that they ascended to a height of 10,000 feet, where they found an air current traveling Europeward with a high velocity. Such is the belief of Mr. Roland Rohlfs, the Curtiss pilot who has just made a new altitude record of 31,000 feet, and who expects to ascend to 33,000 feet or higher in a new flight.

The rarefaction of the atmosphere increases rapidly once an altitude of 30,000 feet is reached, and several writers on the subject have in recent years mentioned that for this reason particularly they do not believe that aviators will ever ascend higher than 40,000 feet in an open-type machine, where they have to breathe the ordinary atmosphere, even with the aid of oxygen supplied from a tank. This belief has been voiced by Mr. Harry E. Dey, a well-known American engineer, in an article which appeared some time ago in *Aeronautics*. He gives several other reasons therein for his faith in this belief. As the figures show in the accompanying illustration, the air pressure has been reduced about 60 *per cent at a height of 26,000 feet,* or 4.9 miles above sea level. Here we find the air pressure has dropt to 10.9 inches on the barometer, equivalent to 5.37 pounds per square inch. Such a marked reduction as this, as proven in all altitude flights so far attempted, have a very strong and undesirable effect on the flier. It affects the pulse or heart beat, the respiration, and in fact every part of the body, causing in some cases severe nausea, and at times fainting spells, when the pilot cannot tell whether he is flying upside down, sidewise, or in normal position. Major Schroeder, the American army flier, had all these sensations and more in his 105-minute ascending and 20-minute descending trip at Dayton, Ohio.

Let us look at the air pressure and temperature at 31,000 feet, or 5.8 miles. An official test made by the U. S. Weather Bureau at Huron, S. D., in the month of August shows an air pressure of 4.6 pounds per square inch, or a reduction of 68 per cent in the pressure found at sea level, where the aviator started to rise, probably no longer than an hour previously. Imagine

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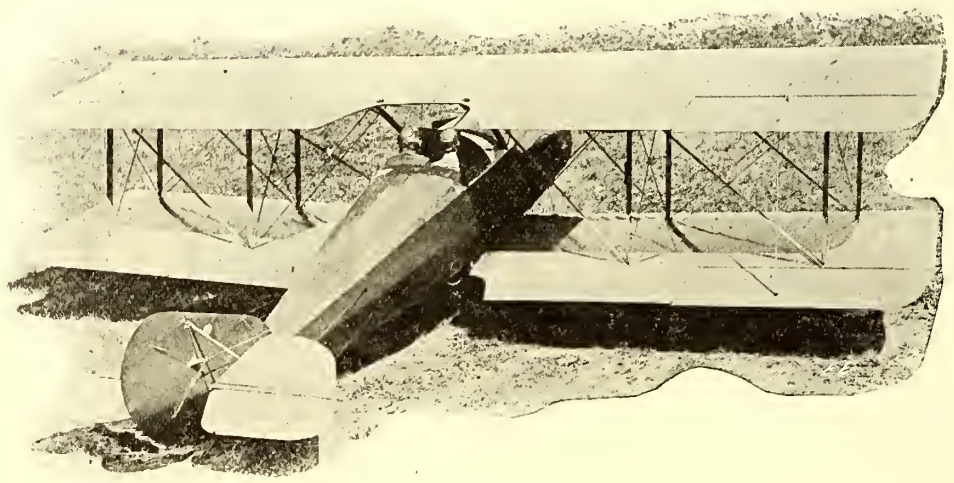
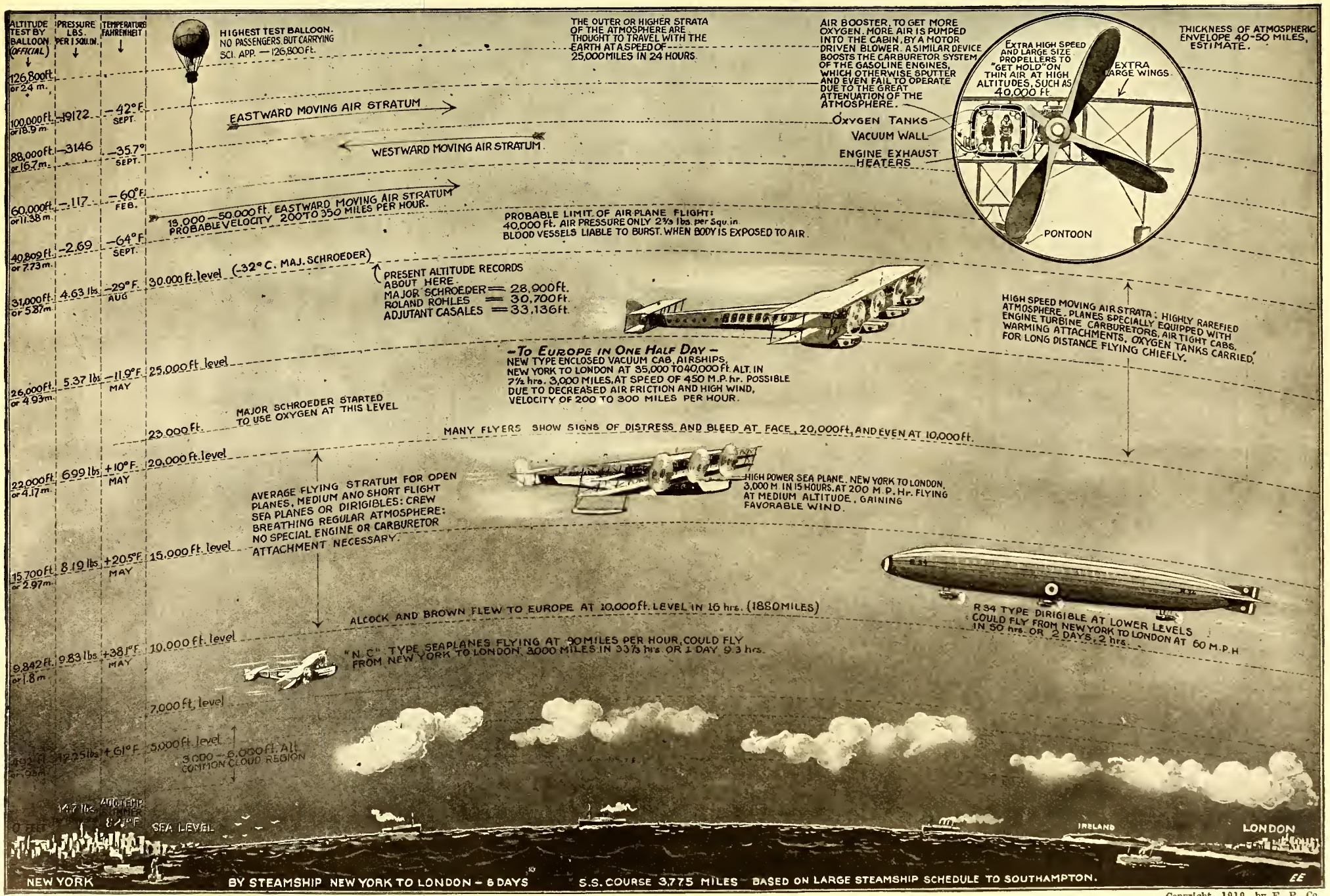


The Thomas-Morse Airplane that Established a new Gliding Record of 35 Miles. A Glide of 35 Miles with a Dead Motor was Recently Made by R. C. Marshall, Test Pilot for the Thomas-Morse Aircraft Corporation. It Is Said that this is a World's Record for Gliding. "Tex" Marshall, as He is Called, Flew from Ithaca to the Head of Cayuga Lake, a Distance of 35 Miles, and Then Flew Upward Until He Reached a Height of 17,500 Feet. He Then Cut Off His Motor and Glided Toward Ithaca. When He Reached the City, It Is Stated, He was Still at a Height of More than a Mile, and Might Have Glided Fifteen Miles Further.



To Europe in one-half day and possibly in three hours—that sounds almost preposterous and impossible to say the least, does it not? But a scientific study of the peculiar atmospheric conditions existing in the higher altitudes, such as thirty thousand to forty thousand feet, gives great promise, as several authorities have pointed out, of giving us airplanes of to-morrow which will so far surpass the present aircraft that there will be no comparison. In the first place, the upper air strata is known to travel at a very high velocity, which will carry a plane at from three to four times its sea-level speed. Besides all this, the rapid decrease in air friction would enable the plane to go much faster than at lower levels where the air is denser. "Vacuum cab" airships will undoubtedly have to be used to fly at the higher altitudes with extra large wings and propellers to support the craft in the thin air.

Can Radio Ignite Balloons?

The Opinions of Nikola Tesla and Other Radio Experts

AS a result of the newest theory, that powerful induced currents emanating from the Naval Radio Station in Chicago produced the spark that ignited the Goodyear dirigible airship which plunged in flames thru the roof of a bank building in that city, resulting in death for thirteen persons and injury to twenty-seven others, naval communication officers will aid the authorities in fixing responsibility for the disaster. It was ascertained that technical experts had suggested *this* theory, because the big ship sailed over or near the Transportation building, from the roof of which are projected the antennae of the Naval Radio Station. The building thru the skylight of which the blazing dirigible fell was the Illinois Trust and Savings Bank.

Lieut. F. S. Mason, of the Great Lakes Naval Training Station, district communication service officer, while refraining from agreeing with the theory, said he would cooperate with the investigating officials. Pilot John Boettner, of the ill-fated dirigible, said he had not been aware of the location of the naval radio station. H. M. Byllesby, head of a large engineering corporation and foreman of the coroner's jury of technical men, said experts had suggested the *radio theory* to him.

Col. J. C. Morrow, chief air officer of the central department of the army, the principal witness at the inquest, was a passenger in the dirigible on a trip preceding the fatal one. At that time he said the ship was in safe condition. The pilot he considered competent. He thought the possibility of sparks from the exhaust igniting the gas bag very remote, but said he had not formed an opinion as to the cause of the accident.

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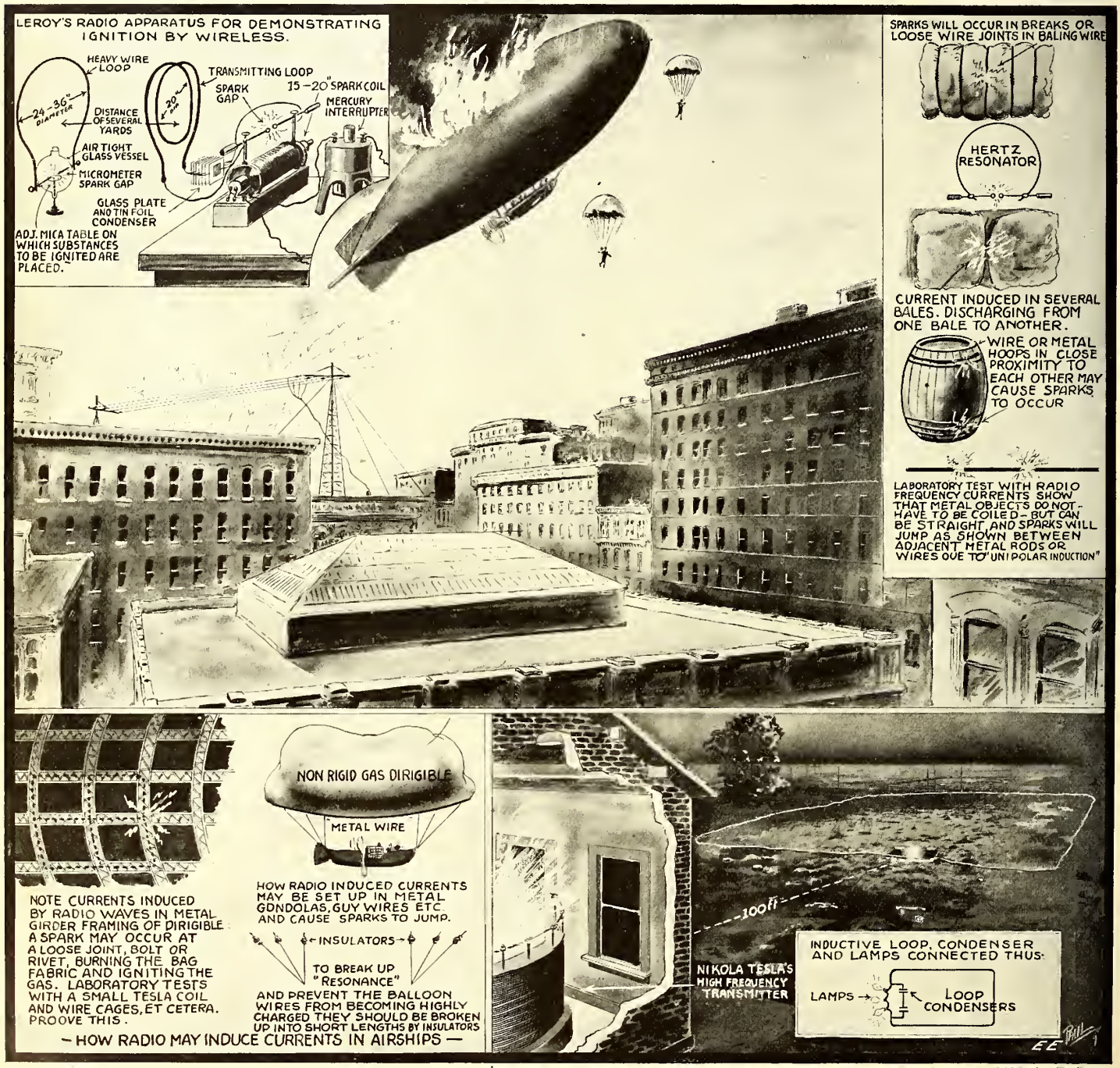


Herewith Are Shown Some of the Plausible Reasons Why the Recent Chicago "Blimp" Disaster Might Have Been Caused By a Spark Induced By An Adjacent Radio Station. The Photo In the Lower Right-hand Corner Shows Three Incandescent Lamps Lighted to Full Candlepower, At a Distance of 100 Feet from Dr. Nikola Tesla's Colorado High Frequency Power Plant. The Oscillator Was Worked At Less Than Five Per Cent of Its Total Capacity.

"Piped Cold"—Prof. Bell Has It

IN the July issue of the ELECTRICAL EXPERIMENTER, the Editor advocated the *piping of cold air* to various parts of dwellings and office buildings, using, if possible, the wintering steam piping systems and radiators. Well, great minds, etc. Here comes prolific Dr. Alexander Graham Bell, inventor of the telephone, airships, and ship salvage schemes, with an actual working installation of "piped cold." This idea occurred to Dr. Alexander Graham Bell when the Washington weather became extremely sizzling. Former President Taft, when he was in the White House, had a refrigerating device put in the offices, which since has fallen into disuse, but Dr. Bell believes he procured better results by his "home made" cooling arrangements in his Connecticut Avenue residence. In a communication to the *National Geographic Society*, Dr. Bell describes how he tricked the thermometer out of some 35 degrees—and you can try this out in your own home if you are "handy" about the house. Says Dr. Bell:

I have found one radical defect in the construction of our houses that absolutely precludes the possibility of cooling them to any great degree. You will readily understand the difficulty, when you remember *that cold air is heavier than warm air.* You can take a bucket of cold air, for example, and carry it about in the summer time and not spill a drop, but if you make a hole in the bottom of your bucket, then, of course, the cold air would run out.

I began to think that it might be possible to apply the bucket principle to at least one room in my Washington home, and thus secure a place of retreat in the summer time. It seemed to be advisable to close up all openings near the bottom of the room to prevent the escape of cold air and open the windows at the top to let out the heated air of the room.

Now, it so happens that I have in the basement of my house a swimming tank, and it occurred to me that since this tank holds water, it should certainly hold cold air; so I emptied the water out to study the situation. The tank seemed to be damp and the sides felt wet and slimy.

I reflected, however, that the condensation of moisture resulted from the fact that the sides of the tank were cooler than the air admitted. Water vapor will not condense on anything that is warmer than itself, and it occurred to me that if I introduced air that was very much colder than I wanted to use, then it would be warming up in the tank and becoming dryer all the time. It would not deposit moisture on the sides and would actually absorb the moisture there.

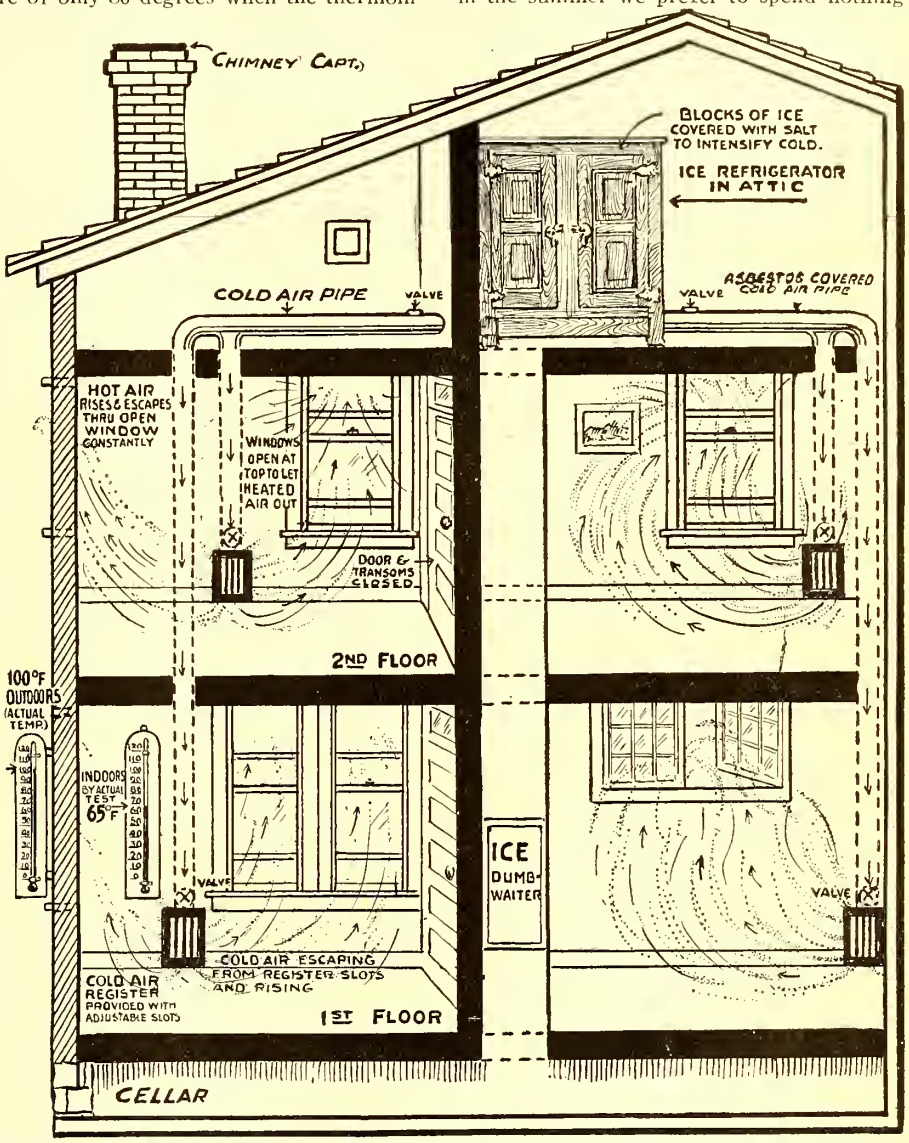
I therefore provided a refrigerator, in which were placed large blocks of ice, covered with salt, to intensify the melting and freezing action of the ice. This was placed in another room at a higher elevation than the tank, and a pipe, *covered with asbestos paper,* was employed to lead the cold air into the tank.

The first effect was the drying of the walls, and then I felt the level of the cold air gradually rising. At last it came over my head. The tank was full, and I found myself immersed in cool air. I felt so cool and comfortable that it seemed difficult to believe that Washington stood sizzling outside. I climbed up the ladder in the swimming tank until my head was above the surface, and then found myself breathing a hot, damp, muggy atmosphere. I therefore speedily retreated into the tank, where I was perfectly cool and comfortable.

Guided by this experience, I tried another experiment in my house. I put the refrigerator in the attic (see drawing herewith) and led the cold air downward thru a pipe covered with asbestos into one of the rooms of the house. The doors were kept shut and the windows were opened at the top. The temperature in that room was perfectly comfortable, *about* 65 *degrees!*

Some time ago the papers were speaking of an ice plant that had been installed in the White House, and congratulated the President, then Mr. Taft, upon a temperature of only 80 degrees when the thermometer showed 100 degrees outside. Under similar conditions (100° F. outside), I enjoyed in my home a temperature of 65 degrees (the ideal temperature), with a delicious feeling of freshment in the air.

The system proposed by Prof. Bell occupies very little space. In fact, it could be placed very easily in tenement houses utilizing the area between the ceiling and the roof, as all houses have at least a three-foot clearance between these two points. No doubt in the future, owners of houses will be compelled to install cooling systems.



"Piped Cold"? Sure! Why Not? Said Prof. Alexander Graham Bell, Inventor of the Telephone. In His Washington, D. C., Residence He Installed a Refrigerator in the Upper Story as Here Shown. The Cold Aid Descends Thru the "Pipes," and Chases the Heated Air Out Thru the Open Window Tops. 100° F. "Outside" and 65° F. "Inside"—Tells the Story. It Works!

ORIGINAL EDITORIAL BY H. GERNSBACK IN THE JULY ISSUE

One of the most profound annual summer mysteries of the twentieth century—at least to the writer—is our hot office or our hot home. We would not think of an unheated house or office in the dead of winter with the temperature near the zero point, but curiously enough we allow ourselves to suffer cruelly from the heat in the summer time when the temperature rages up in the nineties. Is it not a most curious world in which we live?

We think nothing of spending fabulous sums in the winter for our coal supply in order to keep warm and comfortable. But in the summer we prefer to spend nothing and suffer untold misery in consequence. Babies and grown up sick folk die like flies by the thousands on account of the heat, while we stand by helpless, or rather as if we were devoid of all intelligence, while the totally unnecessary slaughter goes on incessantly. How our grandchildren will read with astonishment that for decades human beings had their houses piped for heat, but had not enough sense to run a freezing solution or other freezing agent thru the self-same pipes in the torrid summer days!

There might be an excuse for our criminal negligence if we had not the means at hand to keep us cool and comfortable in summer. But we really have all the means, all the apparatus; in fact, everything—including:

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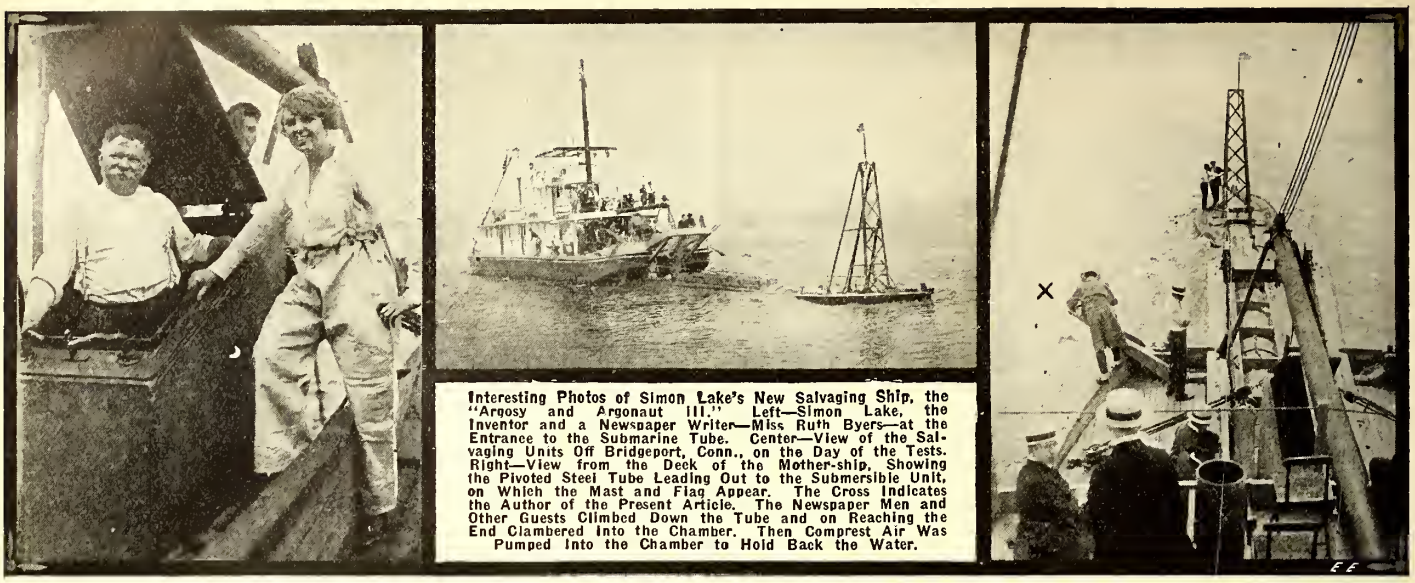


Interesting Photos of Simon Lake's New Salvaging Ship, the "Argosy and Argonaut III." Left—Simon Lake, the Inventor and a Newspaper Writer—Miss Ruth Byers—at the Entrance to the Submarine Tube. Center—View of the Salvaging Units Off Bridgeport, Conn., on the Day of the Tests. Right—View from the Deck of the Mother-ship, Showing the Pivoted Steel Tube Leading Out to the Submersible Unit, on Which the Mast and Flag Appear. The Cross Indicates the Author of the Present Article. The Newspaper Men and Other Guests Climbed Down the Tube and on Reaching the End Clambered into the Chamber. Then Comprest Air Was Pumped Into the Chamber to Hold Back the Water.

Photo © by International Film Service

Reclaiming Sub-Sea Treasures

By JOSEPH H. KRAUS

Walking on the Ocean's Bed Without a Diving Suit—Simon Lake's Newest Invention

A LETTER.

"We expect to have our first press trial of the 'Argosy and Argonaut' on Friday morning, August 1st.

"Very truly yours,

"SIMON LAKE.

"Dictated but not signed."

THIS was a portion of the letter from the inventor of the modern submarine which greeted me not so long ago. With August 1st coming on the next day, it meant hustle and get out. So the two of us, my camera and I, departed for Bridgeport. The next morning found me at the Stratford Hotel with a party of about forty editors and cameramen, representing newspapers, photograph agencies and motion picture concerns, all there bright and early awaiting our trip to the salvage ships. Not very long afterward a short walk brought us to the pier to which one of Mr. Lake's vessels was moored. A little joking while the refreshments were being placed on board, the blow of a whistle and we departed for the open sea. About one-half hour's ride brought us to the good ship *Argosy and Argonaut.* This is a combination of two ingenious devices used for ship salvaging and wreck recovering. The "mother ship," about 100 feet long, has a 65-foot tube connected to it in a little *well* in the forward part of the ship. At the end of the tube is the submarine, which is hinged directly with it so that entrance may be effected thru the tube while the submarine is at the bottom of the water. A few trips around the vessel while the cameramen ground out hundreds of feet of "movie" news film and the submarine going thru maneuvers, demonstrated to us the ease and safety with which the device would work.

The launch which was taking us around soon pulled up alongside of the salvage vessel. We clambered on board once more, all ready for the descent, a demonstration of which was to be given in a very short time. Mr. Lake then singled out the parties, four or five of which went down into the tube at a time, and each group had some of the most interesting stories to tell. Altho before starting down I thought songs like "Nearer, My God, to Thee" or "Asleep in the Deep" would have been very appropriate for the occasion, no one even as much as hummed them. We were all too engrost in the surroundings and awed by the masterful engineering spectacle around us.

THE DESCENT.

A hatchway measuring about 3 by 4 feet opens into the 65-foot tube, which latter tube is well lighted by electric lamps, the current for which is supplied from the mother ship. Current is likewise provided to actuate all the mechanisms in the submarine. The tube, 4½ feet in diameter, has struts across the bottom. These struts are 6 inches apart and assist in getting a foothold in the tube. A rail on each side helps to hold you in a "hunchback" position. It is necessary, in order to descend in this tube, to stoop over, and for safety's sake to go down backward, as a "bump on the bean," as someone called it, is not such a pleasant thing to get, and there is less chance of "bumping" in walking down backward than in attempting to go down the other way. Furthermore, the body would not have to be bent at such a great angle descending backward. Soon the tube narrowed, and instead of the rail on each side, a large number of steel ribs greeted our clutching fingers. Mr. Lake being first, directed us to wait a while, and started to release the air pressure in the diving chamber. A hiss of escaping air and dense clouds of mist filled the lower end of the tube completely. Shortly a massive iron door opened, just large enough to admit a person's body. "All in!" and we filed thru the opening, or rather crawled thru it. We now entered the equalizing chamber, about 5 feet long and 3½ to 4 feet wide. Swinging the door closed again, Mr. Lake opened the valve which admitted air, so that the pressure in this chamber would be the same as that in the operating chamber.

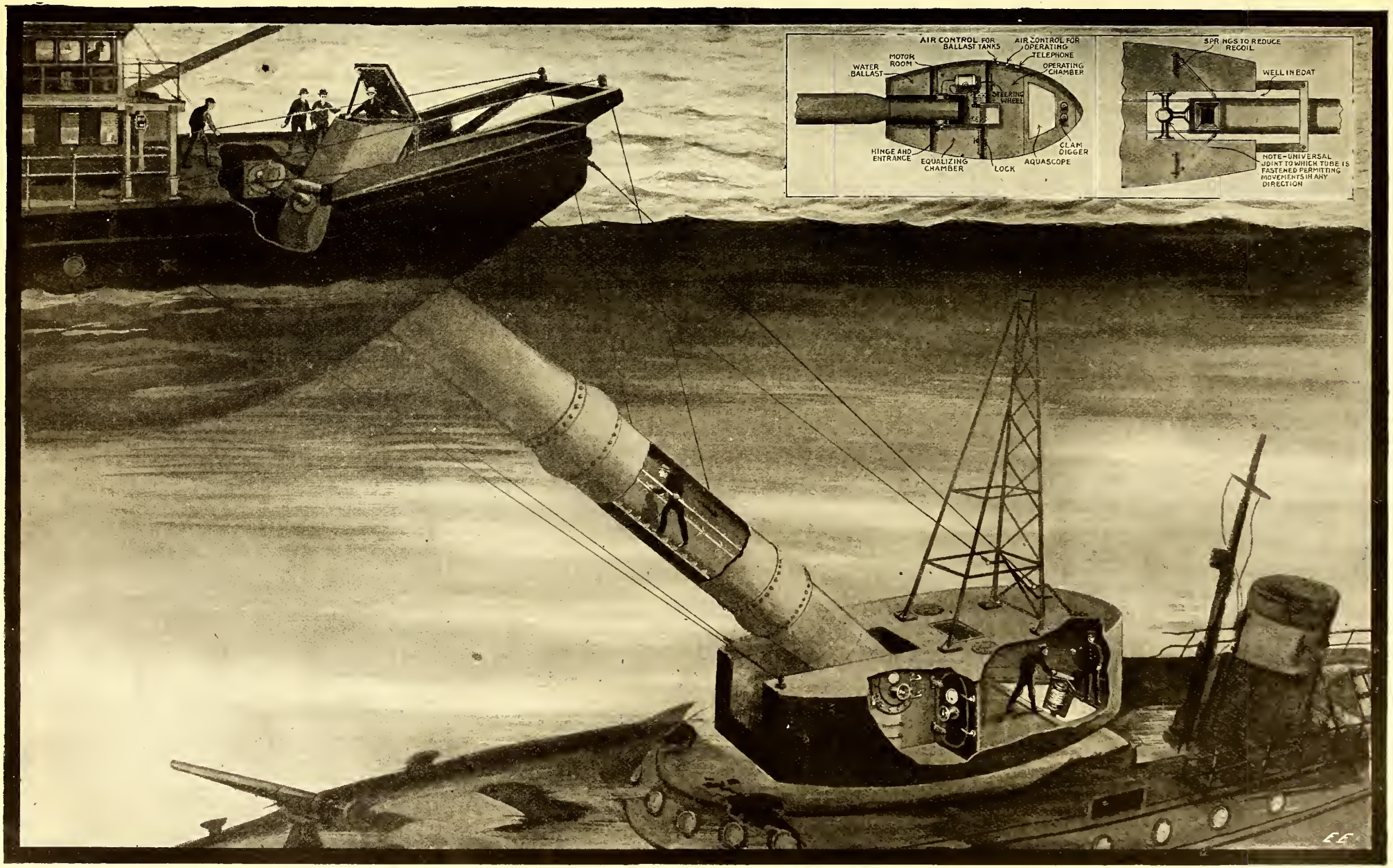
"Should you feel deafening in your ears, swallow," were Mr. Lake's words. Well—we swallowed! It reminded me more of "evolution" than anything else in my life. Have you ever been to the aquarium, and noticed the way some of the big fishes gulp water so as to oxygenate their blood? Well, that was *us.* The door into the operating chamber now permitted its being opened as the air chamber was equal in pressure.

This room is about 9 feet long and 8 feet wide at its broadest point, and sort of triangular in shape. What immediately attracted our attention was a hole in the floor of this chamber. There in front of us was a sheet of water about 6 inches deep, perfectly smooth on top with glistening white sand beneath. It seemed as tho it had been smoothed out and the sand cleaned for our reception. A signal, and the submarine moved forward, the water under us passing in slight ripples, and the sand moving away quite rapidly. Some of the most wonderful seaweed and shells were past, which could be seen easily with the use of no lights whatsoever, the water being of a beautiful translucent green (it's mighty hard to keep a swimmer out of water of that nature). A short time down in the operating chamber completed our visit to Father Neptune, and we again past thru the air-lock in order to give some of the others a chance to see this most wonderful spectacle.

HOW THE SALVAGE SHIP WORKS.

Now a word about the apparatus. The *Argonaut,* which is the mother ship, is 100 feet long with a beam of about 45 feet. It is driven by two 75 horse-power gasoline engines. These drive two propellers each, one forward and one aft. The propellers are so arranged that the forward pair may be disconnected, whence each engine drives the ship by means of the rear propeller. A very complex system of signalling is used on this vessel. The devices work by electricity or manually, by means of which the officer on deck can signal the engineer below in the engine room. In this engine room also is a 125-volt generator driven by an independent engine coupled to it. The energy derived from it is used to charge storage batteries, which supply the 110-volt D.C. for the lights and motor appliances used in the "sub." An air pump operating constantly supplies the air pressure for the "sub" and maintains a pressure of 75 to 80 lbs. per square inch at all times.

There is another extremely ingenious idea which Mr. Lake has incorporated in his salvage work. The device referred to is a semaphore arrangement on the masts of the salvaging ship. This semaphore consists of two arms, which are operated



Simon Lake's New Salvage Machine for Reclaiming Sunken Vessels

Hundreds of millions of dollars' worth of cargo and ships lie sunken in the ocean and in coastal regions, which can be salvaged either partly or in whole, when the proper engineering means have been provided. It appears that the new salvaging vessel recently perfected by Captain Simon Lake, of submarine fame, will perform such operations in a very expeditious and efficient manner; and this belief is all the more strengthened by the successful tests made during the past August in Long Island Sound in the vicinity of Bridgeport, Conn. Captain Lake made successful explorations of the bottom of Long Island Sound at depths up to 50 feet and over. The principle of the device is as follows: A mother ship of fairly large proportion carries a pivoted steel tube at one end as the illustration above herewith shows. The lower end of this steel tube which forms a passage-way for the salvaging crew, is fitted by means of a large pivot joint to a "submarine" as it is called, and which in fact it really is. When one climbs down thru the tube, he finds himself in a rear chamber of the "submarine" and directly he passes thru an air-lock door, shown in the plan view above, into the forward air-lock. In this forward compartment air at high pressure is constantly forced in thru a pipe passing down thru the pivoted tube. This air pressure keeps the water down to the level of the floor. There is an opening in the floor as shown and the crew may walk on the sand of the bottom as the submarine is pushed along by the mother vessel. The present illustration shows two men sawing off the starboard light on the sunken "Mary Alice", an armored yacht.

from the deck, by means of which signals are transmitted to the two smaller vessels which accompany the *Argonaut*. These smaller vessels are known as *wreck-finding vessels*, much speedier than the salvage ship (*Argonaut*), and at the same time smaller in size. They are likewise equipt with semaphores for replying to signals. In this way Mr. Lake can guide the course of the wreck-finding vessels without the use of wireless. The submarine proper is 22 feet long and divided into a motor room, opening into the left hinge, and an equalizing chamber, opening at the right hinge, thru which we had to pass in order to reach the operating chamber up forward. On each side and to the rear are two ballast tanks; also one midway between and below these. A large 110-volt motor actuates the wheels under the submarine proper. This motor is controlled from the operating chamber, i. e., the forward-most chamber of the submarine, and is likewise steered from this latter chamber. By its means the *Argosy*, or submarine proper can rest on the bottom of the ocean. These traction wheels under the submarine may be steered in any direction, and the mother vessel may, by this means, be drawn along by the action of the submarine itself, the submarine having the mother ship in tow, so to speak. Entering the right equalizing chamber from the tube, there is a massive iron door (which seems strong enough for a safe) with heavy latches. The door in the equalizing chamber is closed and comprest air is admitted slowly so as to allow the body to become accustomed to the increase in atmospheric pressure. When this is done gradually there is no grave risk.

A Remarkable "Pre-War" Caviar Map of the World's Greatest Ship Graveyard. The Wrecks Pictured Have All Occurred During a Period of Fifteen Years. This Great Loss of Shipping Was One of the Principal Causes Leading Up to the Construction of the Kiel Canal. This Chart Was Prepared, Before the War, by the German Hydrographic Office. Captain Lake's Submarine Salvaging Scheme, Which He Has Successfully Demonstrated, Represents an Invention that Is Expected to Reclaim 75 Per Cent of the $6,000,000,000 Worth of Ships and Cargo Lost During the War. Altho Simon Lake, the Inventor of What for a Better Name Might Be Called a "Salvaging Submarine," Gave His Demonstration Off Penfield Reef, Near Bridgeport Harbor, Conn., He Declared that It Would Be Just as Successful Where the Waters Were 300 Feet Deep. Tests Have Been Successfully Made at a Depth of Fifty Feet. The Salvaging Submarine Really Consists of Two Boats, the Argosy and the Argonaut. The Argonaut Is the Mother Ship and the Argosy the Submarine Attachment or Submarine Tube that Can Be Lowered or Raised by Means of Powerful Engines on the Mother Ship. A Larger Vessel with a Tube 300 Feet Long Is Being Planned for Use in Deeper Waters. One of the First Vessels to Be Salvaged Will Be the Bark "Hussar," Which Was Sunk in Hell Gate, N. Y., During the Revolutionary War with a Treasure of $5,000,000 in Gold on Board.

Some notion of what a difference in air pressure may make can easily be understood when one realizes that every foot below the water level there is an increase of .43 pound on every square inch of the body surface, which means an increase of 1,376 pounds for the entire body. Under normal conditions, the body is subject to a pressure of 14.7 pounds per square inch, which is atmospheric pressure. At a depth of 150 feet the pressure is more than four times that to which we are accustomed, and is an additional 64½ pounds per square inch, or 32,250 pounds increase on body over atmospheric pressure. Under these circumstances the blood is driven back from the surface of the body, the veins become deplete of blood, and a greater amount of blood is forced into the arteries, hence causing the heart action to be of necessity a good deal stronger in order to force the blood thru the contracted arteries. For much the same reason, a deafening sound is produced. This is due to the fact that air pressure on the diafram of the ear (tympanic membrane) causes an inward depression of the diafram

The Eustachian tube which connects the middle ear with the buccal cavity, normally closed, opens a slight fraction of a minute during each swallow, and by this means allows for an equalization of the air pressure on both sides of the tympanic membrane. That is the reason Mr. Lake gave us orders to swallow on opening the valves, which would increase the pressure to that of the water at that depth. Even at depths of 40 to 45 feet the sudden *descent* may prove dangerous, and a too hasty *ascent* may be followed by intense bleeding of the nose and ears, and perhaps a more dangerous hemorrage in the body. All troubles of this nature are due, as we have said, to hasty ascent or descent. There are several pathological reasons for death, which may result from causes such as these, but as that is more a matter for the medico, it will not be discust in detail here.

THE OPERATING CHAMBER.

This chamber is divided up into a forward portion and the controlling portion. Up forward is the *Aquascope*, or underwater telescope, by means of which one can see out into the water. That is to say, the Aquascope is a large glass door, which will allow a person to look thru it or open it and get out and walk, so to speak. There is a depth of 6 inches of water from the interior of the chamber to the bottom of the ocean or deck of the vessel when the submarine is in position, so it's just as easy to walk here without getting any wetter than if wading in a brook. In this chamber likewise is a telephone, which communicates with the deck of the "mother vessel," as are likewise controls for all operations, such as derricks, degrees of air pressure and signals. In the aft portion of the submarine are three air tanks, which are placed one at each side, and one in the center and below the other two. It is only necessary to allow the water to pass into these containers, and the increase in weight will carry the submarine to the bottom, or anywhere midway between. It may likewise be forced out and the submarine made to rise to the surface.

The tube itself is hinged in such a manner that an up and down motion does not materially affect the submarine, neither does the side to side motion of the mother ship have any effect. A sort of universal joint, very powerfully constructed, holding the tube in position, while ropes connected to the pulley blocks on the deck prevent the tube from rocking either way to a great extent, due to the fact that these blocks in turn connect to springs.

Is salvage practical commercially? Well, let us quote a few cases. *La Lutine*, an old hulk of a British frigate, sailed from Yarmouth Roads for Hamburg on October 9, 1799, carrying a large amount of treasure in the form of gold and silver bars and coin. She struck a sand bank at the entrance of the Zuyder Zee and was lost. The minimum estimate of the coin on board is valued at $2,085,335. All attempts to recover the treasure have been futile, or nearly so (only $500,000 having been reclaimed), altho its location is exactly known. Inasmuch as the position in which she lies is an exposed place, divers have been unable to recover the cargo. Vessels around Hell Gate and other treacherous Atlantic ports can be easily salvaged—or at least their cargoes salvaged.

As for salt water spoiling cargoes, Mr. Lake has recovered cotton which has been submerged from two to five years, nothing but a very slight portion having been spoiled. Silk has likewise been recovered. Hardly any article decreases in value, even tho lying at the bottom of the ocean for a long period of time. Not only may cargoes of this nature be recovered, but also coal, a special device being utilized in this case. It will be noted in one of the photographs that a well runs down thru the center of the submarine. In this well is placed a hose running to a centrifugal pump, located on the deck of the mother ship. Nor does this pipe call for the services of a diver, as it can be brought into position by means of either an electric winch, or by lowering the submarine over the space where the coal is to be pumped. Mr. Lake's present vessel is, of course, by no means a large salvaging ship, nor will its operation be as cheap as a much larger vessel capable of doing much more work. Coal has been recovered from the bottom at an actual cost of less *than* 5 *cents a ton*, 15 *tons having been recovered in a minute*. It has been said that coal submerged in salt water is a good deal better than coal which has been left in the open, inasmuch as it burns away almost entirely, leaving a pure soft white ash. Hence many housewives sprinkle salt over their fires to make them brighter.

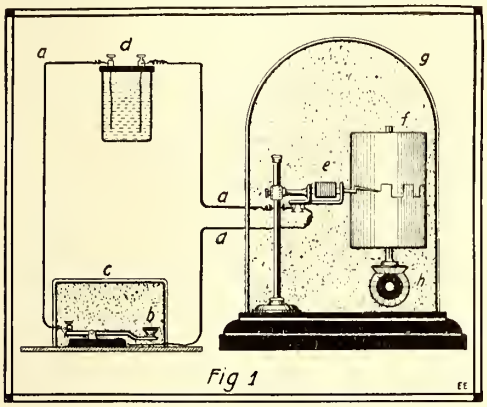
A very wonderful method of salvaging sunken ships has also been conceived and worked out by Mr. Lake.

Investigating "Psychical Phenomena" With Scientific Instruments

By HEREWARD CARRINGTON, Ph. D.

An Account of Some Recent Researches In This Field of Inquiry

IT is generally conceded that Aristotle possest the greatest single intellect the world has ever known; yet any schoolboy today knows more of the structure of our universe than did Aristotle! The reason for this is that Science has more fully penetrated the secrets of Nature, and we now know approximately the constitution of matter and a good deal concerning life and mind. How has this progress been possible? Only in one way. Improvement in the *mechanical instruments* by means of which we study Nature. We might "speculate" as to the constitution of matter for a thousand years, but we should never have arrived at our present positive *knowledge* had it not been for the delicate and sensitive instruments which are today in the hands of the physicist and the chemist, and employed by him in his laboratory.



In a Series of Séances Conducted in Naples, the Apparatus Here Shown Was Used to Investigate the Psychic Phenomena. The Psychic "Power" Successfully Prest the Key, Thru a Cover, and Caused the Magnet Needle to Record on the Revolving Drum.

Doubtless much the same law will be found to apply in the realm of "psychics." Until we can apply definite "laboratory methods," and study psychical phenomena by means of physical instruments far more delicate than our senses, it is probable that the present state of things will continue to exist; but it is my firm belief that, were a laboratory fitted up with physical and electrical apparatus, suitable for this work, and if we could by their aid study a promising case of "psychic" or "mediumistic" phenomena, we should (within ten years or so) arrive at some definite conclusions! We should then know something about the *laws* and conditions under which telepathy, clairvoyance, telekinesis (the movement of objects without contact), et cetera, operate, and not until this is done, I believe, will such positive conclusion be reached.

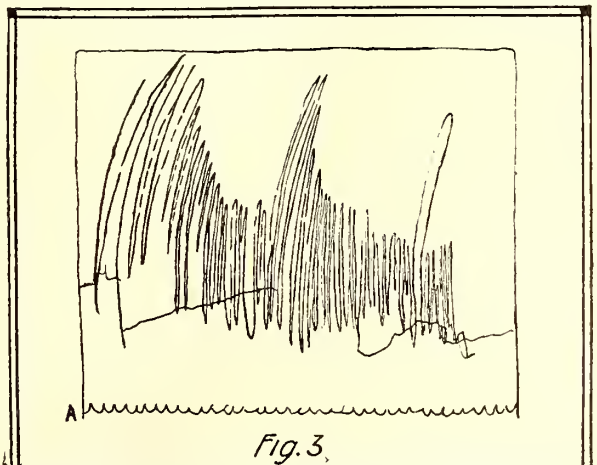
Of course the reader may object, just here, that I am assuming such phenomena to be *true*—while the tendency of many present-day scientists is to regard them as unreal, hallucinatory, and the result of fraud. I cannot spare the time in the present article to argue the point. While I admit freely that a very large percentage of such phenomena *are* so produced, and while I freely admit that probably 98 per cent of so-called "mediums" are fraudulent; I am equally emphatic in declaring that a residuum of genuine phenomena exists—that supernormal manifestations *do* occur, and that everyone who investigates *carefully enough* and *long enough* will find them. This has been not only my own experience, but that of every person who has investigated this subject with an impartial mind for any length of time. As Sir Oliver Lodge said, in writing of this very question:

"The result of my experience is to convince me that certain phenomena, usually considered abnormal, *do* belong to the order of Nature, and as a corollary from this, that these phenomena ought to be investigated and recorded by persons and societies interested in natural knowledge."

Based on this conviction, Sir Oliver Lodge wrote, as far back as 1894, in a paper entitled "On Some Appliances Needed for a Psychical Laboratory":

"If the investigations are to go on easily and well, special appliances must be contrived and arranged conveniently for use, precisely as is done in any properly fitted laboratory. It has already doubtless been realized that one of the needs of the future is a *psychical laboratory*, specially adapted for all kinds of experimental psychology and psychophysics. . . ."

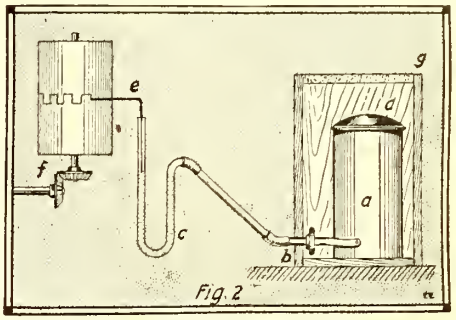
Sir Oliver Lodge suggested at the time, among other necessary appliances, a delicate registering balance,—so adjusted that it would record the medium's weight, unknown to her, at all times during the séance—the fluctuations in weight, if any, to be recorded on a revolving drum. Means ought also to be provided for studying the temperature, pulse, muscular exertion, breathing, etc, etc. The lighting of the room should be carefully attended to and capable of the slightest gradation. Means should be provided for obtaining moving pictures of the séance from without the room, unknown to the medium. Were the sittings held in complete darkness, these photographs could be obtained by means of ultra-violet light, with which the room might be flooded. In addition to these devices, we may add others—such as X-ray tubes, high-frequency currents and a delicate field of electric force,—while instruments for testing the ionization of the air (if it exists) in the immediate vicinity of the medum, during a séance, should also be employed,—together with the more strictly psychical instruments and devices which have been utilized of late years.



A Sample of the Tracings Obtained By Psychic Powers Acting On the Apparatus Shown At Fig. 2.

Electrical apparatus *has*, in fact, been utilized on several occasions to test so-called "psychical mediums" in the past. Italian investigators, particularly, have excelled in this. In a series of séances conducted in Naples, the following apparatus was employed. (Fig. 1.)

A telegraphic key (b) was connected by wires (a,a) to a battery (d) and to two screws, connecting them with an electro-magnet (e) to the opposite end of which was attached a needle. The point of the needle touched a revolving drum (f), with a smoked surface, driven by two interlacing, cogged wheels. The whole of this registering apparatus was enclosed under a glass bell-jar (g). The telegraphic key itself (b) was covered by a cardboard box (c). The "powers" manifesting were asked to press the telegraphic key *without* tearing the cardboard box (that is, *thru* it). When the key was deprest, this would be instantly communicated to the electro-magnet, and cause the needle to oscillate,—these oscillations being marked upon the smoked surface of the revolving drum. A number of successful tests were conducted by means of this apparatus.



Another Form of Psychic Force Recorder. Here the Pressure Exerted On the Rubber Cap "d", Thru the Cloth "g", Caused the Liquid in Cylinder "a" to Move Downward and Actuate the Manometer Needle "e", Which Traced the Variations On a Revolving Drum "f".

A variation of this was then employed (Fig. 2). A cylinder filled with water (a) was connected by means of tubing (b) to a U-tube, or manometer (c), filled with mercury. Upon the further side of this tube floated a bent wire (e) inserted into a small cork. The point of this wire, again, was so adjusted as to come into contact with the smoked surface of a revolving drum (f), driven as before. The top of the cylinder (a) was covered with a rubber cap (d), and this whole apparatus was inserted under a wooden box (g) having a cloth top.

Now, if the rubber covering (d) were prest upon, this would force some of the water, in a, along the tube, b, and the added air-pressure would depress the column of mercury in the manometer, causing the floating needle to rise on the opposite side, and scratch upon the revolving drum. Fig. 3 shows some of the tracings which were obtained in this way—the force acting thru the cloth top, g.

The instruments thus recorded a *definite physical, intelligent force.*

It may interest my readers to know that, at the time of his death, M. Curie,—who had been completely

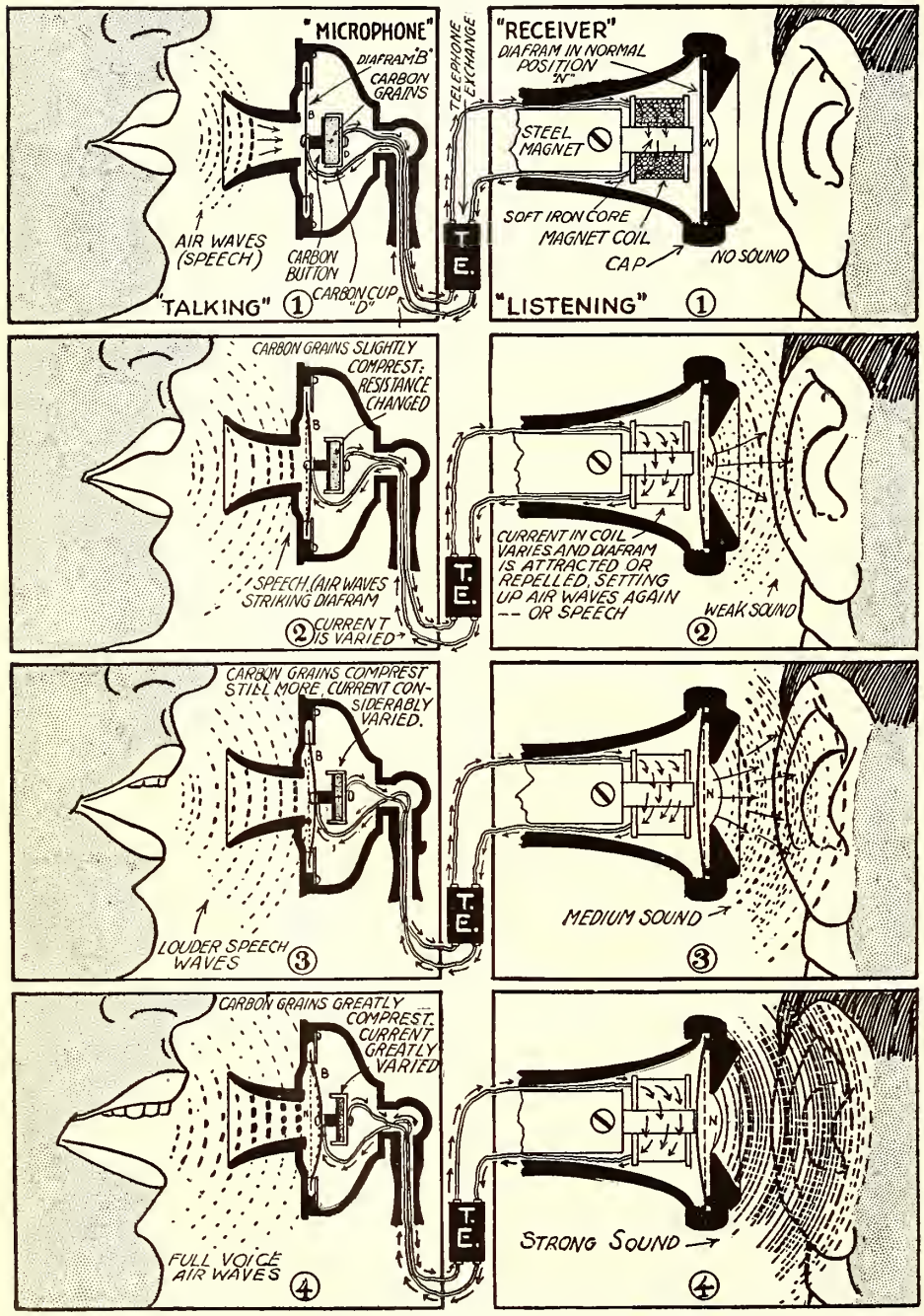
(*Continued on page* 566)

How the Telephone Talks

ALMOST all of you use a telephone constantly and give very little thought as to the actual working of it. Just how many people know what happens when you throw your voice into the transmitter of the modern telephone? Very few, I'll warrant. By means of the drawings, the transmitter is very clearly shown in detail, and the voice may be traced from the time it leaves the mouth until it goes into the line thru the transmitter. The whole operation, of course, takes place almost instantly.

Fig. 1 is the detailed construction of the transmitter. A is the mouthpiece; B is a very sensitive iron or mica diafram; C a carbon button and disc attached to the diafram B; D is a small box filled loosely with carbon granules.

When you speak, the resulting air waves set up by your voice impinge against the diafram B, which vibrates in exact tune with the air waves. The carbon disc C, being attached to B, also vibrates in syntony with the air vibrations, and therefore the contact between the carbon granules and the carbon disc varies in proportion to the force of the air waves striking against the diafram. As a consequence of this action, the electrical resistance between the carbon disc and the carbon granules varies with the strength of the air waves.



"How the Telephone Talks" Is Here Illustrated in Diagram and Picture. This Shows, of Course, Only a Few of the Actions Occurring in "Telephoning"—In Fact the Action Here Taking Place Occupies But a Fraction of a Second.

Consider Fig. 1, which shows schematically the telephone transmitter or mircrophone as well as the receiver, reproducing the spoken word, and which was employed in the manner shown by the Bray Studios in making an animated film story entitled "How the Telephone Talks."

Fig. 1 shows the exact instant that the mouth starts to open when a vocal air wave is set up as indicated by the curved dotted lines. The air waves tend to expand spherically whenever possible, and the vibrations or rings representing the air waves expand rapidly (the velocity of sound thru air being about 1,100 feet per second), and, as will be evident, the expanding air wave will, in the fraction of a second, reach the tightly stretched microphone diafram just inside the mouthpiece, to which is attached one of the carbon electrodes forming the carbon granule chamber. This stage of events in the story of the telephone is illustrated at Fig. 2. Here the first ripple of the expanding air wave propagated from the vocal organs and mouth of the speaker, is just impinging against the diafram and causes it to bend inward as shown. When the mouth first starts to open, Fig. 2, the air waves are quite weak. The movement of the microphone diafram and the carbon electrode attached to it is consequently slight, as well as the change in the current thruout the circuit to the receiver at the other end of the line. At this stage it is well to look at the receiver, Fig. 2, in which we see that the diafram has been attracted inward, or toward the electro-magnet core, by the increased strength of current caused by the reduction in the resistance of the carbon granules in the microphone. Simultaneously an air wave corresponding in frequency and pitch to that originated by the speaker at the transmitter end of the circuit, is thus produced by the movement of the receiver diafram. As becomes evident, the strength of the reproduced sound or air waves which eventually leave the receiver diafram, causing the mechanism of the ear to respond in the well-known physiological manner, will be exactly proportionate to the strength of the original sound or sounds at the transmitter.

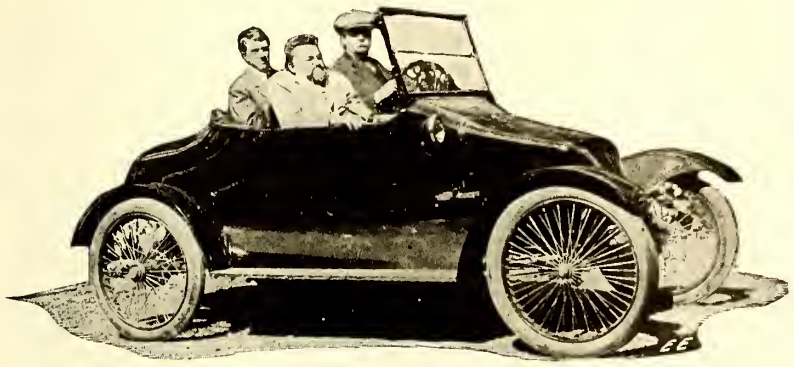
At Fig. 3, the speaker's mouth has, a few seconds later, opened wider and the speech waves are louder and more powerful. These stronger air waves strike the microphone diafram thru the mouth-piece and cause it to move in a still stronger manner, which in turn causes a greater compression of the carbon grains, as shown in Fig. 2, and the receiver diafram is attracted or repelled with proportionately greater effect. If a medium strength sound is produced by the speaker at the transmitter end of the circuit, then the sound reproduced at the listening end would be a medium strength sound also.

Fig. 4 shows one case of a full, loud voice condition on a telephone circuit. The full vocal power air waves set up by the speaker opening his mouth to the normal maximum strike the microphone as shown. The carbon grains are in turn compress to a greater extent, more so than in Fig. 3, and the current in the circuit is now intensified decidedly, owing to the porportionately greater change in the resistance of the carbon grains, and the receiver interprets these changes very faithfully. The greater variations of the current in the transmitter-receiver circuit affect the receiver magnet by passing around the coil of wire wound on the end of the magnet as shown, and these powerful changes are instantly communicated to the diafram, attracting it with great vigor, so that it almost touches the magnet poles in some cases. The diafram now vibrates back and forth with maximum movement, giving forth sonorous air waves corresponding to the waves originated at the transmitter. The human ear held close to the receiver interprets the air wave vibrations in the well-known manner, and thus we hear once more the voice of the speaker transmitted perhaps over several hundred or several thousand miles of telephone wire, reproduced in our very presence, mysteriously—yet very simple, when you know how it is done.

A New Era Electric Auto

A New Combination Gas-Electric Car

THE new Dey Electric Automobile here illustrated created a mild sensation some time ago, and in an interview with Dr. Charles P. Steinmetz, the latter made the statement that Mr. Dey had solved the problem of the



The New Gasoline-Electric Automobile Which Its Inventor—Harry E. Dey, Seen at the Wheel,—Expects to Sell at $500.00. At the Left—Dr. Charles P. Steinmetz, the Famous Electrical Engineer, Who Believes Mr. Dey has the Best Idea Yet in Electric Automobiles. The Storage Battery Is Charged While Running.

$500.00 electric automobile. This car has many points of novelty over other vehicles. It naturally follows that such must be the case in order to cut the weight and cost of the lightest and cheapest electrics now on the market in half; and at the same time not reduce the factor of safety, or the size of the car, which has the same dimensions as the Ford.

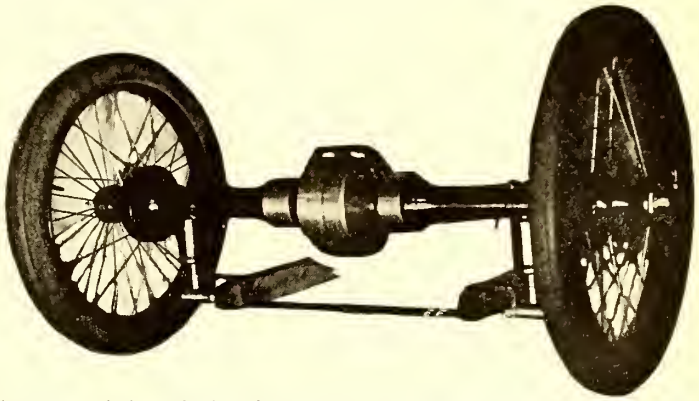
Its most revolutionary feature is the motor, which has *both its armature and field magnet rotatable;* one element connecting with one driving wheel thru a pair of reduction gears, while the other element connects in a similar manner to the other wheel. This arrangement produces a perfect *differential* substitute; and, in addition to saving the cost and weight of this complicated piece of mechanism, *it increases the capacity of the motor* 100 *per cent* for a given rotative speed, for the parts revolving in opposite directions *cut the magnetic lines twice as fast,* thus producing the results of a motor of double the velocity; besides this also adds to the electrical efficiency. The weight of this motor is still further reduced by turning it inside out, as it were; the armature, which is a toothed Gramme ring, encloses its field which has six poles, all energized from one coil. The field design is ideal for low field losses and light weight; its total weight, with shaft, being less than 20 pounds. Its iron portion is well adapted for drop forging. The total weight of the motor, which has a capacity equal to the standard automobile motors weighing 150 pounds, and upward, is but 51 pounds.

The motor is centered on the center line of the axle. An eccentric, of 7/32 inch throw, is fixt to the outer end of each shaft; an internal gear is carried by, and rotates upon, the field shaft eccentric, a roller bearing taking care of the friction. An external gear, concentric with the shaft, is keyed fast to the stationary housing and meshes with the internal gear; the latter connects by means of a flexible jointed shaft, practically a floating axle, to the wheel hub. It will be noted that only one of the gears is rotatable, the other one being held absolutely rigid. At the armature shaft end the construction differs by mounting the external gear, instead of the internal one, upon the eccentric, and keying the internal one to the housing. From this point the construction duplicates the other end. When the internal gear is the rotative element, as at the field shaft end, the direction of rotation remains unchanged between the motor and the wheel; but with the external gear as the rotating member, as used at the armature end, the direction is reversed. The opposing directions of the armature and field magnet are thus rectified without recourse to intermediate gears. The internal gears are 3½ inches pitch diameter and the external 3 1/16; this gives a reduction ration of 7½ to 1.

This car can well be termed the *nutless* car, there being so few used in its construction; all the surfaces are free of any bolt head projections. As the current is taken into the motor by means of slip rings there is no necessity of disconnecting wires when removing motor.

The experimental car was designed with a hand operated control and wheel steering. It was found in testing this out in heavy traffic, however, that hand control and wheel steering do not make a desirable combination, for in an emergency both hands are required upon the wheel; and in addition there is a time element involved in shifting the hand from the wheel lever that cannot be permitted. In the latest design the control is very similar to that of a gas car, with the shifting of gears left out. For speed variation a foot lever is used in a manner identical with that of the clutch lever; when the foot is removed the car runs at full normal speed; a slight pressure inserts resistance, producing the equivalent of a slipping clutch; as the pressure is increased resistance is added by infinitesimal steps, until finally the current is completely shut off; further movement converts the motor into an electric brake, and an extreme movement applies the mechanical brake. There is besides an additional emergency brake and also the ability to reverse the motor, thru resistance, for that purpose. An accelerator pedal, acting upon the field, increases the speed to 30 miles per hour, or more. Another lever provides "Forward," "Reverse" and "Neutral"; it is interlocked with the speed control, so as to shift only when there is resistance in the circuit or the motor is entirely cut off. The ability to reverse while the power is still on (thru resistance) provides quick manipulation for "seasaw" work.

On down grades the motor will recharge into the battery at speeds as low as eight miles per hour; and the car speed will automatically *slow down* as the grade increases; thus making the driving unusually safe. An increase of speed may be obtained at any time, however, by means of the accelerator.

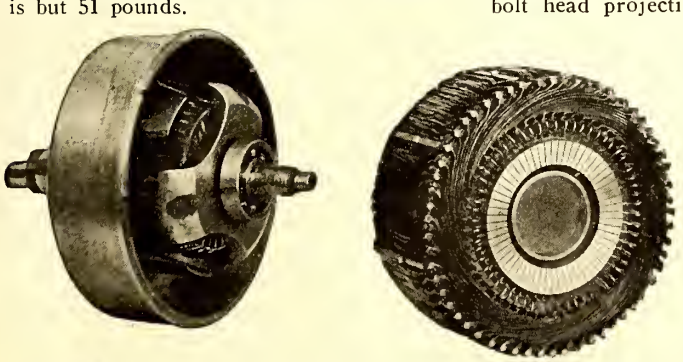


The Rear Axle and Electric Motor Propelling the New "Dey" Electric Vehicle. It is Twice as Efficient as the Ordinary Electric Auto, Owing to the Fact That Mr. Dey has Designed His Motor to Have the Field and Armature Both Rotate. This Doubles the "Torque Speed" and Reduces the Weight of the Motor. Also the Storage Battery Is Smaller Than in Any Other Machine.

The storage battery is carried beneath the floor, attached to the truss rod posts. This permits the body to be used exclusively for passengers and luggage; and also avoids all troubles due to spilled electrolyte. The method of suspension is such that the battery can be readily lowered to the floor by one person, and the top is accessible for adding water by lifting a trap door in the floor. This location is ideal for small power consumption, and gives a very low center of gravity that conduces to an easy riding and safe car.

While light weight has always been a hobby with the inventor, he does not believe in obtaining it at the expense of reliability or a limited sphere of action. One-half of the total weight of a car should be charged against the battery; this will provide power in excess of 100 miles per

(*Continued on page* 562)



The "Dey" Electric Auto Motor—at Left, the "Revolving Field"—at Right, the Revolving Armature and Internal Commutator.

"Jerry Up"

By CHARLES K. FANKHAUSER, JR.

Late of the 56th Regiment of Engineers, U. S. A., Only Searchlight Regiment in the A. E. F.

THE author wishes to state that the following is an account of some of his personal experiences with the 56th Searchlight Engineers during six months of active service in Flanders.

After the usual cross-country tour of France *à la box cars* (always labeled 8 *chevaux*, 40 *hommes*, meaning 8 horses, 40 men), and a week's pleasant (?) sojourn in a rest (?) camp, Co. F. arrived at Champigny, near Langres. It was here that we were to receive our training in the gentle art of bagging Hun 'planes. Our searchlight "training" was merely a continuation of "squads east and squads west," punctuated at frequent intervals with the refreshing (?) pastime of manicuring France with pick and shovel.

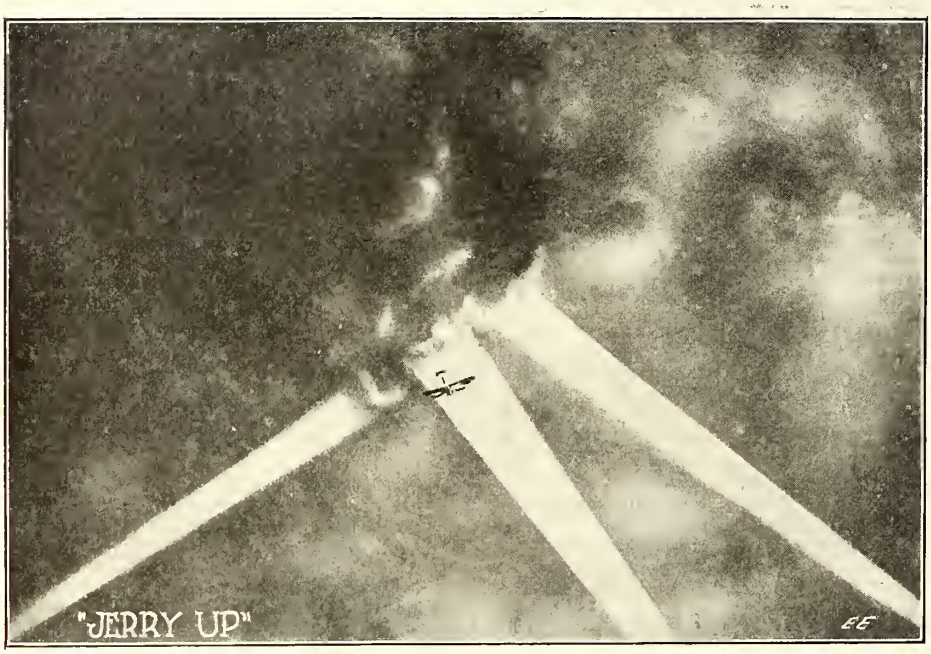
But there is an end to all things. One fine afternoon early in August, 1918, found me, with six others from Co. F., at S.3., S.3 being the official title of one of a series of English searchlights strung along the "India rubber" line near Lille. There we learned what a searchlight really was for. We couldn't help it.

That evening, shortly after dusk, "Jerry" started over in his giant bombing 'planes to get the big steel plant just behind us. We wanted to leave the immediate vicinity *"toute suite,"* but no! We were informed by the hilariously amused "Tommies" in charge that we not only had to stay there, but had to shine a big sixty centimeter light right on "Jerry." We protested that he could hit us quite easily enough without our "advertising" our location. But once again—no! We had it all wrong. The sergeant ordered us to take action. We got the light on a big Gotha and immediately down came six bombs! Wang-o!! and then some. The jar of the first blew the arc out in the light and the rest blew out all our ambition and desire to be "defenders of Democracy."

After our first scare it wasn't so bad. We learned that a searchlight is a very poor target, even tho it is somewhat conspicuous. After that it was just a thrilling game. "Jerry" was an awful coward when it came to the limelight stuff. He preferred to work in the dark. Just as soon as we got him into the beam he invariably dropt his presents and made tracks for home. That is, he tried to. He did not always succeed. Our three-inch A.A.'s sometimes interfered. (A.A. in plain United States means "anti-aircraft.")

The three-inch guns were another little diversion for us. We had frequent practical illustrations of the law of gravity much in the same manner that Newton first observed it. Only our apples were made of *steel.* Said apples being originally intended for "Jerry." He being directly over our heads, and aforesaid steel failing to reach its objective, it returned to us by the shortest possible route. A straight line. (Business of digging out tin lids in a hurry.)

Did the German Airplanes Like the Allies' Searchlights? Yes They Did—NOT!



Actual Photograph of a German Bombing 'Plane Caught in the Shafts of Allied Searchlights. This Photo Was Taken From an Allied 'Plane. "Jerry" Was Tickled Silly to Have His Path Illuminated; Yes, He Was—and Showed It by Dropping 100-Pound "Forget-Me-Nots" on the Searchlight Crews—Fine, Only They Made Such an Awful Noise When They Landed.

Our parabaloid sound locators would tell us when a 'plane was coming and give us the bearing, then I, being wheel man, would send the long finger of light searching out into the blackness, looking for "Jerry."

The alarm was always given "Jerry up," and when we heard that, there was "action" and lots of it. I'll say so.

Each light had quite an elaborate telephone system, with lines running to several "spotting" posts and connected with all the other lights and gun sections thru a central telephone exchange.

This telephone system was a fine idea. The only thing wrong with it was the fact that the French farmers had a strange fondness for double-strand, cotton covered field telephone wire, and we never could convince them that we did *not* put the wire down for them to play with or build fences with. Otherwise the system was fine, and gave us many hours of diversion repairing it. Especially after a line had been plowed, harrowed and scraped for an afternoon or so.

The third night out I bumped up against the real English alphabet. I was on duty at the 'phone board. S.4 rang in and this is what I got: "Esses 3? Message to Lieutenant ——. Ac-ac-esses 4. Eight pip-emma, eight oblique fifteen oblique eighteen. Esses-e-n-don emma-e-esses-esses-ac-g-e t-a-ac-don-j-u-t-e-n-t——"

That was enough for me. I thought the whole B.E.F. was shell-shocked. I went for help. My mistake. It was only the usual "Pip Emma" system. The system of spelling used in all telephone communications in the B.E.F. Certain letters that are apt to be confused with others are given a special pronunciation as, s is pronounced "esses," p is "pip," m is "emma," d is "don," b is "beer," a is "ac."

I finally got the main idea of the thing, but never used it. When we "Yanks" used the 'phone we talked United States, not English.

But taking it as a w(hole) an A.A.S.S. emplacement isn't half bad—providing it doesn't rain and there are no rats and no cooties, and you don't mind sleeping in mud and—oh, well, if you like that sort of thing and don't care particularly whether you sleep or not.

SEARCHLIGHTS AND SOUND DETECTORS IN THE A. E. F.—A CORRECTION.

We publish herewith a correction from the War Department, office of the Chief of Engineers, Washington, D. C., concerning our article on page 310 of the ELECTRICAL EXPERIMENTER for August, 1919, entitled "Locating Airplanes in Night Fighting." To quote Captain James O. Jensen, Corps of Engineers, U. S. A., in his communication: In the third column it goes on to say:

These powerful searchlights, besides being available for enemy spotting, are also much used as a means of signalling. This is one branch of **the Signal Corps'** *work which has proven one of the big factors in helping to win the war.*

The particular work described in the article is a function of the Corps of Engineers, and was not and is not handled by the Signal Corps.

The 56th Regiment of Engineers constituted all the searchlight personnel in the A. E. F., and was the only organization engaged in using searchlights and sound detectors to combat enemy night flying 'planes.

EX-SOLDIERS, ATTENTION!

We want to publish some more articles similar to that appearing on this page by Mr. Charles K. Fankhauser, Jr., describing personally some first-hand experiences with the American Expeditionary Forces. Of course such articles intended for publication in the ELECTRICAL EXPERIMENTER should deal with more or less scientific phases of military life in France. Not only do we extend this invitation to all ex-military men, but also to the sailors of the sea. There is many a good tale to tell based on facts, we are certain, from the many personal experiences we have heard related by our friends who went overseas from time to time.

Good Day! Mr. Mars, said Prof. Todd

A SERIOUS attempt to get into communication with the planet Mars was made at Fort Omaha on Sunday, July 13, when Prof. Avis Todd of Amherst, accompanied by Capt. Leo Stevens, head instructor of the balloon service of the War Department, tried to send a balloon to the highest point ever reached. Capt. Stevens holds the world's record of 29,500 feet, made at Franklin, Pa., in 1912.

Prof. Todd has perfected instruments upon which he has been working for years, is the report from Fort Omaha, and with these he hoped to get into communication with the people of Mars, providing he could get far enough away from the earth's attraction.

Six years ago Capt. Stevens took Prof. Todd to a height of 22,000 feet, but his effort then to communicate with Mars failed. Five years ago Prof. Todd went to the Andes in South America for the same purpose but failed again.

One of the Government's big spherical balloons was used.

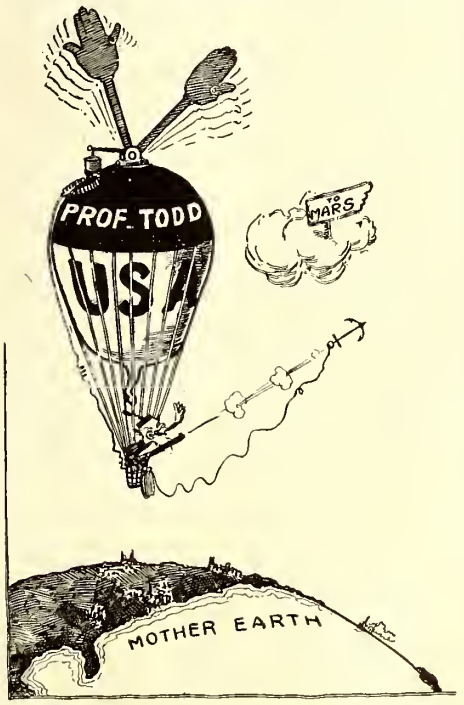
WHAT SIR OLIVER LODGE SAYS.

Communication with other planets by wireless telephone is not regarded by Sir Oliver Lodge, one of Britain's most eminent scientists, as a possibility too fantastic to be summarily dismist by savants.

Projection of a stream of electrons across the spaces of infinity by employing the vacuum relay or "audion" and utilizing ultra-violet light or the X-ray—these and other equally marvelous visions are conjured up by Sir Oliver in an article in *The Mail,* of London, under the caption of "Shall We Talk to Other Planets?"

Sir Oliver Lodge is inclined to believe that some simpler and more direct mode of transfer of ideas will be developed, but he does not censure William Marconi for his enthusiasm as to the possibility of interplanetary communication by wireless telephony.

"The wonders of wireless telegraphy and wireless telephony," says Sir Oliver, "are the outcome of researches in pure science which were originally initiated and pursued with no thought of practical application.



Prof. Todd, U. S. A., Sailed Martian-ward Some Moons Ago in a Large Army Balloon, in Order to Try Out Some of His Newest American-Marsotonian Wigwags on the Inhabitants of that Planet—

"By combining all that was known about oscillating electric circuits and about the emission of electric waves in accordance with Maxwell's theory, the problem of tuned or selective wireless telegraphy was solved, let us say, in 1897. Researches initiated by Crookes, and others, and developed by J. J. Thomson, have been prest into the service; and, first by Professor Fleming and then by others, have greatly improved the receiving capacity to wireless stations, so that it is possible in America, with quite a small receiving area, to hear the great high powered radio stations in Europe. And recondite mathematical investigations have proved that hearing at the Antipodes is far from theoretically impossible.

THE EFFICIENT AUDION FOR INTER-PLANETARIAN RADIO.

"In free space there are no such disabilities as are met with in the cramped space of a submerged cable, and speech, said to be of remarkable distinctness, can be reobtained from electric oscillations which have encountered nothing more perturbing than the air. Air does not help—so far as it acts it hinders; vacuum would be better, but the ether is sufficiently forcible to overpower minor obstructions, and it is found capable of transmitting securely and squarely whatever is ingeniously given to it and still more ingeniously received.

"The main instrument made use of for this purpose is the vacuum relay (audion); and the essential power which has been harnest both for sending and for receiving, is the extraordinary mobility and tractability of the little electric units or *electrons* which are given off by matter under certain conditions in great numbers, which fly with incredible speed approaching the velocity of light, and which in a sufficiently high vacuum are beautifully amenable to control.

"Electrons in motion constitute an electric *current* and a stream of them can be deflected either by a magnet or by an electric charge brought near them. Suppose, then, that an oscillating electric charge, oscillating in correspondence with the vibrations of the human voice, is brought into the neighborhood of a stream of electrons, this stream can be made to vibrate in unison. It can be laterally deflected or waved to and fro if that is what is wanted; or it can be alternately encouraged or retarded if that is preferable. It responds to every impulse, and it responds instantaneously.

ELECTRONS FROM A HOT WIRE.

"To get such a stream of electrons many ways might be employed. Ultra-violet light falling on a metal is one method. The X-ray is another. But the simplest plan is to employ a hot wire. A suitable wire can be kept hot by an electric current, and it can be made one of the poles of a battery so that a stream of electrons constantly emerges from it. This stream can then be controlled, as has already been vaguely indicated, by a multitude of devices, some of which have been already described and used—used very effectively—but none of which is as yet likely to have reached perfection.

"That is the principle. The rest is detail. *Fine and ingenious detail,* but detail which can take many forms; and those forms are more suitable for description in the technical press. Suffice it to say that such a device if talked into can supply a current varying with all the tones of the voice; and this varying current can be used to transmit electric waves after the usual methods adopted in wireless telegraphy.

"Then at the other end an ordinary wireless collector can receive them, can reproduce feebly the varying electric currents which originated them, and can then hand them over to a vacuum relay supplied with local energy, where they will modify an electron stream in the way above indicated. The feeble received current can, in fact, so control the stronger electric current which the relay is emitting from a local battery that every fluctuation can be imparted to that stronger current. This electron derived current, relayed again if desired, can then be applied so as to be heard in an ordinary telephone—the marvelously simple and familiar instrument that translates varying electric currents into articulate sound and applies it to the human ear.

—But History Does Not Recordeth What the "Martians" Thought of the Yankee Professor's Signs. Perhaps They Don't Believe in Signs Up There; Anyway, You Probably Locate the Nearest "Near-Beer" Sky Garden by a Mental Telepathic Wave Shot Out Broadcast by the Enterprising "Bevo" Dispenser.

"What the ultimate outcome of this power of long-distance telephoning may be I will not attempt to prophesy.

"The ether waves, once generated, are quite independent of matter. Matter is employed at the sending and at the receiving end, but in all the space between the efficient and necessary transmitting medium is vacuum, ether, the space between the worlds.

"I do not wonder that Mr. Marconi, in his enthusiasm of the power of speech-transmission which is thus coming into being, speaks of possible communication with other planets. Every one, including himself, must foresee immense difficulties about that; and for myself, I venture to anticipate that science will recognize a simpler and more direct mode of interchange of thoughts and ideas, tho perhaps not with dwellers, if there be any, in other planets, before a physical process of transmission from world to world, in the complicated code called *language* is feasible."

Popular Astronomy

By ISABEL M. LEWIS
Of the U. S. Naval Observatory

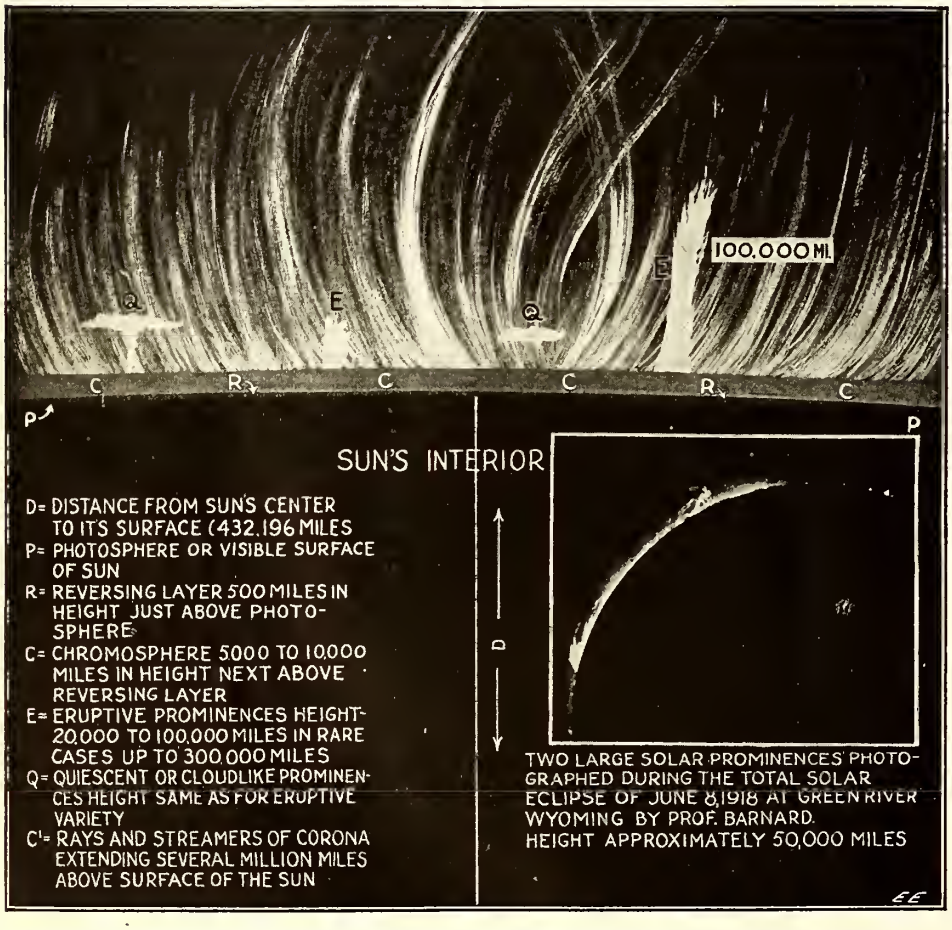
The Surface of the Sun

SUN'S ENERGY UNEXPLAINED MYSTERY.

THE source of the radiant energy of the sun is one of the unexplainable mysteries of the universe. For millions of years the sun has been pouring forth its light- and heat-giving rays at a most prodigal rate without the slightest sign of decreasing strength.

As seen from the sun, the earth is not much more than a point on the celestial sphere, appearing very much as one of the nearer planets, Venus or Mars, does to us.

The amount of the solar energy that is intercepted by the earth must be, therefore, almost infinitesimal compared with the total amount poured forth from the surface of the sun. It has been estimated, in fact, that all the planets together receive less than one one hundred millionth (1/100,000,000) of the total radiant energy of the sun in the form of light and heat, the remainder passing on to the stars beyond at the rate of 186,000 miles per second.



Yet the almost inappreciable amount of energy that our own little planet Earth receives from the sun as compared with the total output is, in reality, *one and a half horsepower per square yard,* or 230,000,000,000,000 horsepower for the whole earth!

It is this seemingly inexhaustible supply of energy that is behind all forms of terrestrial life and activity and if it should fail us the earth would become a barren and lifeless planet in less than one year.

7000° CENTIGRADE.

The surface temperature of the sun is, according to Abbot, at least 6,000°, and may be as high as 7,000°, absolute centigrade, which is 3,000° hotter than the hottest terrestrial source, the electric arc, which is considered to be at a temperature of 4,000° C.

Since all terrestrial elements vaporize in the electric arc, it is concluded that no known element could exist at the surface of the sun except in a gaseous condition. As to the condition of the sun's interior, whether it is entirely gaseous or partly fluid, there is some doubt. The low density of the sun, only one and four-tenths the density of water, precludes a solid interior, and it is now generally considered that the sun is entirely gaseous thruout, tho the tremendous pressure and temperature that must exist far beneath the upper radiating gaseous strata of the sun may produce changes in the elements beyond human comprehension and understanding. *It is even possible that the continual and mysterious replenishing of the solar energy that is poured forth so extravagantly may be brought about by a breaking down of the atoms within the sun's interior and a release of all the sub-atomic energies in a manner analagous to the action of radioactive substances.*

Since we cannot reproduce terrestrially the abnormal conditions of temperature and pressure existing within the sun's interior, we can only speculate as to the nature of the forces at work therein.

When we consider the surface of the sun, however, we are more in a position to understand and interpret correctly the evidence that is furnished us in abundance and in the greatest detail and an understanding of the nature of the forces at work at the surface of the sun and in its enveloping atmosphere may lead later to an explanation of the forces at work far beneath.

THE PHOTOSPHERE.

The visible surface of the sun is spoken of as the *photosphere.* Even the smallest telescopes will show its peculiar "rice-grain" structure, consisting of intensely brilliant flecks or nodules about 500 miles in diameter, which are resolvable by the higher power telescopes into smaller elements averaging 100 miles in diameter, against a darker background. It has been estimated that these bright nodules or rice-grains occupy only one-fifth of the total surface of the sun, yet radiate three-fourths of the total light.

Most astronomers believe that the "rice grains" are the summits of highly heated columns of gas, convection currents arising from the sun's interior, and that the darker portions between are due to cooler descending currents.

It is well known that the photosphere or visible surface of the sun appears to be much brighter in the center of the disk than near its circumference. This is due entirely to its gaseous nature and to the fact that it is surrounded by an atmosphere of dense enveloping cooler gases. Rays from the center of the disk travel a shorter distance thru the sun's atmosphere than the rays from the rim and therefore suffer less absorption by surrounding gases. We look further down into the sun's interior near the center of the disk than in the direction of its circumference.

The photosphere is the region where sun spots appear and they are found in zones extending from 8° to 35° on either side of the solar equator, never appearing exactly at the equator or near the poles.

SUN-SPOTS ARE SOLAR CYCLONES.

The disturbances that produce sun-spots and many allied phenomena occur cyclically in periods of approximately eleven years. The first outburst of the disturbance is manifest in the appearance of sun-spots in high solar latitudes. These break out and disappear and break out again with increased vigor, working gradually downward toward the solar equator. The maximum spottedness for a given period occurring in latitude about 16°. The disturbance finally dies out within 8° or 10° of the equator, but even before one cycle of disturbance has entirely passed away a new cycle has broken forth in high latitudes. So during the period of minimum spottedness there are four distinct belts, two in low latitudes, due to the dying disturbance, and two in high latitudes, due to the new disturbance. At sun-spot maximums there are two well-marked zones of great intensity, approximately 16° north and south of the sun's equator.

Sun-spots are solar cyclones, occurring usually in groups, tho large single spots appear less frequently. Each spot is quite sharply divided into an umbra* and a penumbra.† The umbra is the darker central portion, the funnel of the whirling cyclone, and the penumbra is composed of the outspreading gases. The peculiar "thatch-straw" structure of the penumbra is due, it is believed, to the fact that the

* The dark central part of a sun-spot.
† The boundary of light and shade of a sun-spot.

columns of gases that usually rise vertically from the sun's interior and from the "rice grains" of the photosphere are drawn into a horizontal position in the penumbral regions of a sun-spot and therefore we get a longitudinal rather than a cross sectional view of them.

The umbra of a sun-spot is anywhere from a few hundred miles to fifty thousand miles in diameter, frequently exceeding the earth in size, while the penumbra occasionally reaches a diameter of two hundred thousand miles.

The darkness of sun-spots is only relative to their more brilliant background. Owing to the rapid expansion and cooling of gases the temperature existing in sun-spot regions is far below the normal solar temperature and lies between 3,000° and 4,000° C. At this temperature it is possible for the more refractory chemical compounds to form, the oxides and the hydrides, and the spectra of sun-spots reveal the presence of titanium oxide and magnesium and calcium hydride. At the higher solar temperatures prevailing elsewhere over the photosphere and in its overlying gaseous envelopes all chemical elements occur in a free state, intermingling as incandescent vapors without the formation of any chemical compounds.

Strong magnetic fields exist in sun-spot regions and the sun-spot cycle is attended by marked magnetic changes, not only on the sun, but in the earth's atmosphere as well.

THE SUN'S RADIATIONS.

A most interesting discovery has been made in recent years in regard to the nature of the radiations of the sun. It has been found as a result of continuous measurements of the value of the constant of solar radiation by the observers of the astrophysical observatory of the Smithsonian Institute that the sun's radiations are variable with a two-fold period. One of these has a range of about three per cent during the sun-spot cycle, and the second is an irregular variation with a period of several days, weeks or months and a range that is usually about three per cent, but occasionally runs as high as seven or ten per cent.

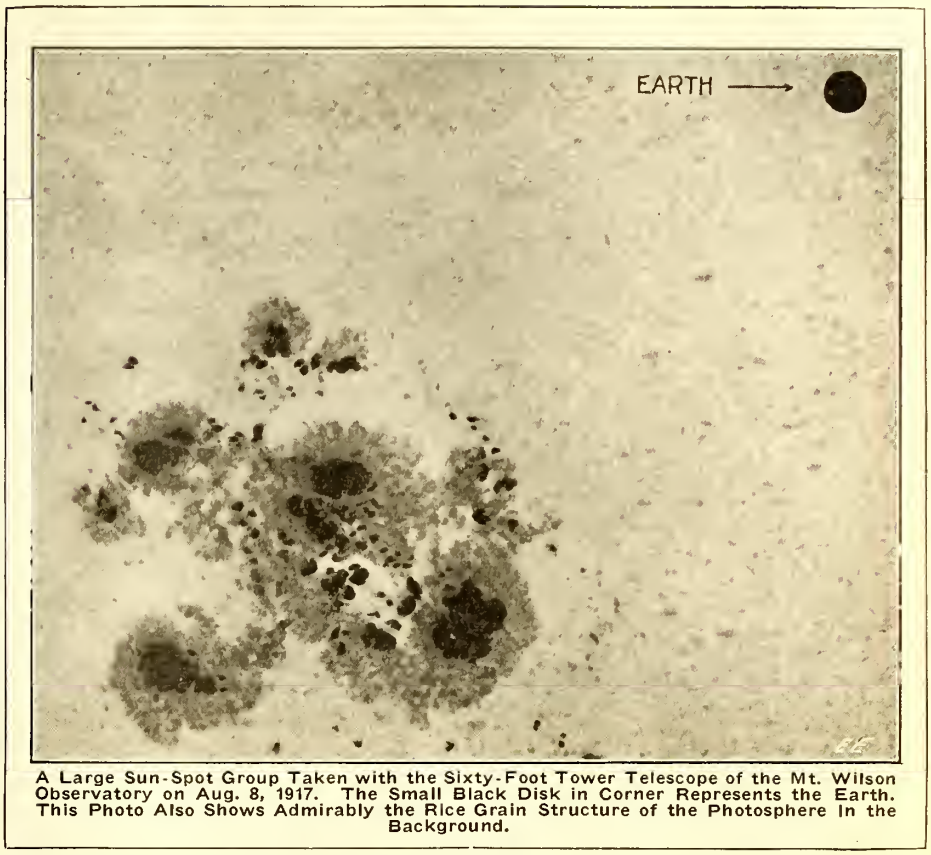
These variations in the solar radiation are considered very important and are now receiving considerable attention since they appear to be attended by appreciable changes in the earth's temperature and weather conditions.

The Smithsonian Institute hopes to establish in the near future a number of stations in widely separated rainless districts of the globe for the purpose of obtaining more accurate determinations of these variations with a view also to making available data for the more accurate predictions of weather changes in various parts of the world.

THE MYSTERIOUS REVERSING LAYER.

Directly above the photosphere of the sun lies the "reversing layer," which is about five hundred miles in depth and is composed of the incandescent vapors of all the chemical elements that are known to exist in the sun, which are also the same familiar elements that exist on the earth. With the exception of coronium, the unknown element in the solar corona, there is no element in the sun that has not been found on our own planet.

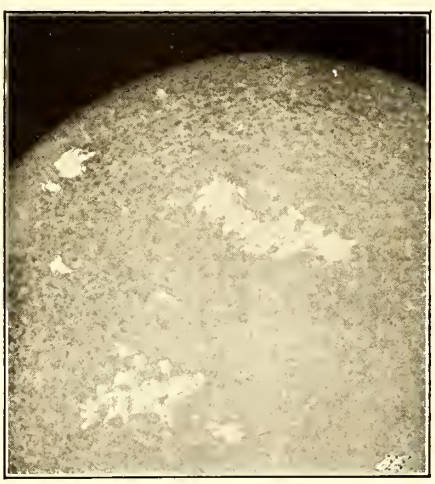
The "reversing layer" receives its name from the fact that it reverses the solar spectrum. It produces the dark absorption lines found in the spectrum that serve to identify all the elements existing in the sun, and during the time immediately preceding and following a total eclipse of the sun it produces what is known as the flash spectrum. When the photosphere, which gives the bright continuous background of the solar spectrum, is concealed by the moon the normally dark lines of the reversing layer—dark only by contrast with the bright background—become momentarily intensely bright lines against a dark background. The flash spectrum only lasts a second or so, as the reversing layer itself is soon covered by the moon.



A Large Sun-Spot Group Taken with the Sixty-Foot Tower Telescope of the Mt. Wilson Observatory on Aug. 8, 1917. The Small Black Disk in Corner Represents the Earth. This Photo Also Shows Admirably the Rice Grain Structure of the Photosphere In the Background.

THE CHROMOSPHERE.

Just above the reversing layer lies the *chromosphere*, which is between five thousand and ten thousand miles in depth. Many of the gaseous vapors of the reversing layer are found in the chromosphere, thrown there continually by the vast upheavals of gases that are constantly disturbing the surface of the sun. The greater the solar activity the more is the chromosphere charged with the vapors of the lower strata of the sun's atmosphere. The gases that are most characteristic of the chromosphere, however, are the incandescent gases of hydrogen and calcium, which give it the pink or reddish tinge so noticeable during total solar eclipse. Helium is also found in great abundance in the solar chromosphere.



This Photograph Shows the Distribution of Calcium Over the Surface of the Sun. It was Taken with the Spectro-Heliograph, an Instrument for Photographing the Sun in the Light of a Single Spectral Ray. The Brilliant White Patches Are Intensely Hot Clouds of Incandescent Calcium Vapor, Referred to as "Calcium Flocculi," Surrounding Sun Spots. The Flocculi Show the Same Peculiar Mottlings or Rice Grain Structure that Is Visible in the Photosphere.

Rising from the photosphere with the tremendous velocity of 100 or more miles per second, it can be seen at all times by properly screening off the light from the photosphere the vast solar eruptions known as the *prominences*. These are composed chiefly of hydrogen, tho other elements also appear, especially near the bases of the prominences. They are of two varieties, the quiescent, or cloud-like prominences, that float high above the solar surface for days at a time in some instances, and resemble terrestrial clouds in form, and the eruptive, or metallic prominences, that dart up from the surface of the sun in an infinite variety of forms that may be entirely changed in the short interval of fifteen or twenty minutes.

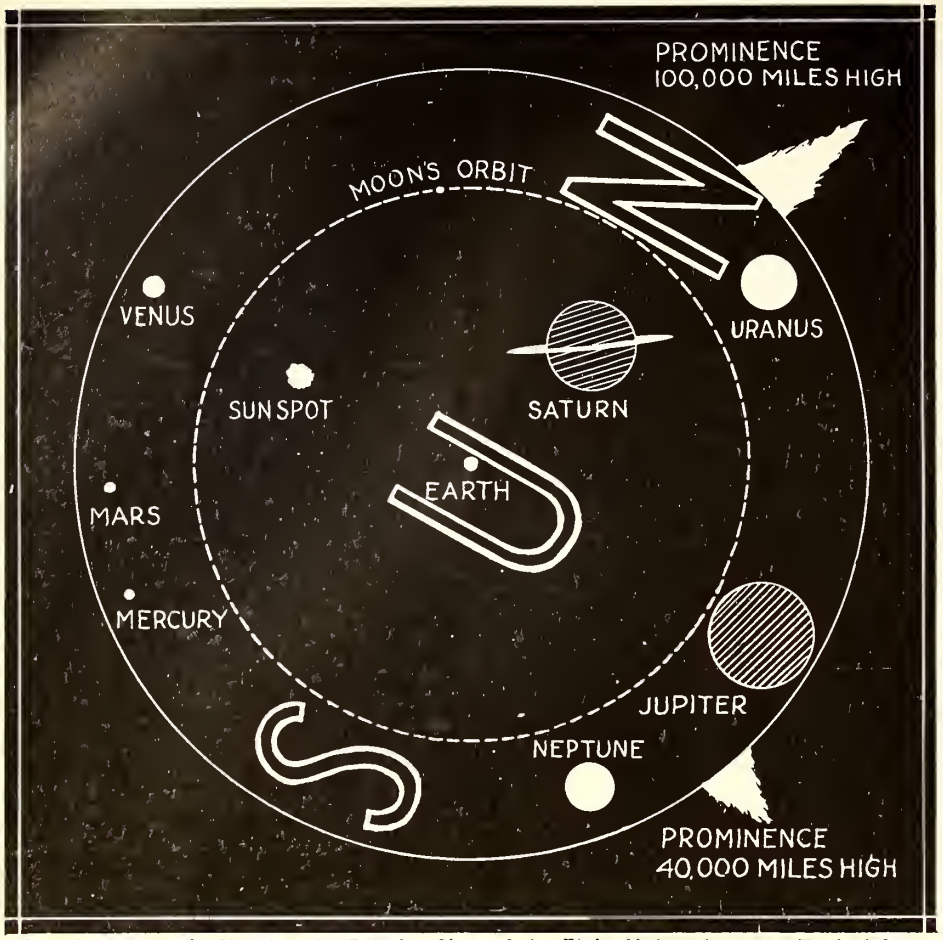
PROMINENCES 300,000 MILES HIGH.

These eruptive prominences usually attain heights of thirty or forty thousand miles on the average, but *exceptional prominences reach heights of more than one hundred thousand miles and in a few rare cases have reached elevations of nearly three hundred thousand miles, or one-third of the solar diameter.*

They are one of the most spectacular and beautiful of all solar phenomena, only second in interest to the solar corona, which is the outermost of all the solar envelopes and also the most tenuous. The extent of the corona is enormous. Its outer streamers extend usually to distances of several million miles from the center of the sun. Measurements of the coronal light during total eclipses of the sun have shown that its intensity is only about one-half that of full moonlight, and it seems almost impossible to devise methods for detecting it, except during total eclipses, on account of this extreme faintness of its light. Experiments along this line are now being undertaken by means of the photo-electric cell, however, and astronomers have not yet given up all hope of detecting the corona in full daylight.

SUN'S CORONA OF ELECTRICAL NATURE.

The corona is largely electrical in its



Sketch Diagram 2—Showing the Relative Sizes of the Eight Major Planets, a Typical Sun-Spot and the Visible Surface of the Sun with Prominence at Edge. (The Planets Appear Projected Against the Disk of the Sun.) The Earth Marks the Position of the Center of the Sun's Disk.

nature, but it shines also partly by reflected sunlight from widely separated particles of matter and partly by light of incandescence, as well as by electrical excitations. The nature of the unknown element coronium has not yet been determined, but its wave length was accurately measured during the eclipse of June 8, 1918, as well as the positions of several other unknown lines in the coronal spectrum, which will greatly aid in their future identification.

The relations existing between the sun-spot cycle and the change in the form of the corona, which is very pronounced, is not yet clearly understood.

The sun, it is now known, is in the midst of a strong magnetic field. Also strong magnetic fields exist in sun-spot regions and the cycle of sun-spot change is attended by marked changes in many forms of solar activity. The frequency of eruptive prominences, the brightness and form of the corona, magnetic storms and weather changes on the earth are all closely associated with the sun-spot cycle.

The cause of this sun-spot cycle, with all the attendant changes in the general solar activity, and the source of the radiant energy of the sun still remain the two chief unsolved secrets of the sun.

QUESTIONS AND ANSWERS.

Question 1. How much would a man weigh on one of the smaller asteroids?

Answer. Most of the asteroids are simply huge mountains of irregular shape but assuming that the average asteroid is approximately spherical in form and ten miles in diameter its surface gravity equals its mass divided by its radius squared, or $g^1 = \frac{m^1}{r^{1\,2}}$ in which all quantities are expressed in terms of the corresponding quantities for the earth.

To find the asteroid's mass m^1 in terms of the earth's mass its volume, in terms of the earth's volume, is multiplied by its density in terms of the earth's density.

It is generally believed that the density of the asteroids is approximately the same as the density of the moon or six-tenths of the earth's density, therefore

$$m^1 = .6v^1 = .6\left(\frac{5}{4000}\right)^3 \qquad \left(\frac{5}{4000} = r^1 \text{ is radius of asteroid in terms of earth's radius}\right) \text{ and } g^1 = \frac{.6v^1}{r^{1\,2}} = \frac{3}{4000}$$

in which g^1 is the asteroid's surface gravity expressed in terms of the earth's surface gravity.

If a man weighs 160 pounds on the earth he would therefore weigh three four-thousandths of 160 pounds on an asteroid ten miles in diameter—*or about two ounces.*

It can also be shown that if he should throw a stone from his hand with a velocity exceeding three feet a second it would never return to the asteroid but would revolve around the sun in an orbit of its own.

Question 2. Will you please explain what the "celestial sphere" is? Why do astronomers refer repeatedly to the "celestial sphere" and yet say that the form of the star system is flattened in the direction of one plane—the Milky Way—and may be a spiral?

Answer 2. The celestial sphere does not actually exist. For convenience in computing the relative positions of all celestial objects such as the sun, moon, planets and stars it is customary to consider that the earth is at the center of a sphere of infinite radius and that the positions of the heavenly bodies are projected upon the surface of this sphere.

The celestial equator, for instance, is simply the intersection of the earth's equator with this imaginary celestial sphere and the Right Ascensions and Declinations of the stars give their positions on this celestial sphere with reference to the celestial equator just as longitude and latitude on the earth give the position of some terrestrial point with reference to the earth's equator.

The ecliptic is the intersection of the plane of the earth's orbit with this imaginary celestial sphere of infinite radius.

The problems of astrophysics dealing with the nature and form of the visible universe are associated with the *actual* relative positions and motions of the heavenly bodies thru space and not with their projected positions upon the celestial sphere of infinite radius.

Question 3. Are sun spots holes in the surface of the sun thru which one sees into the sun's interior? I have seen this view expressed in some text book.

Answer. No. This view was held by some astronomers fifty years or so ago but it is now known to be erroneous.

Sun spots are solar storms or cyclones of a periodic nature with periods of maximum and minimum frequency of appearance. Highly heated gaseous material rises from within the sun to its surface in cyclonic whirls and spreads out over the solar surface, cooling rapidly by expansion. Into the vortex of this whirl are drawn down overlying gases, chiefly of hydrogen and calcium. The darkness of sun spots is due to the fact that the rapid expansion and cooling of the gases in these regions lowers the temperature in sun spots far below the temperature of the normal solar surface and they therefore appear dark in contrast to the more highly heated neighboring surface.

WHAT THE SUN DOES.

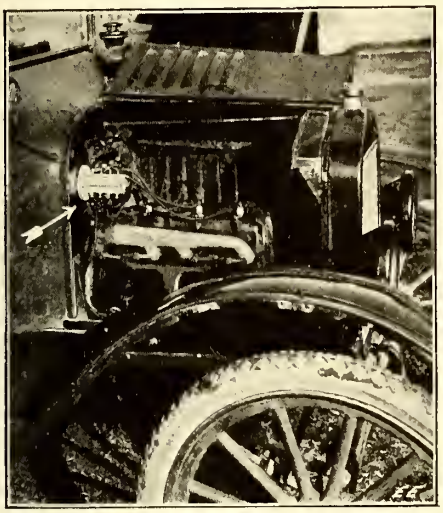
It is estimated that the earth receives every second from the sun enough heat to raise 600,000,000 tons of ice water to the boiling point, or to melt 480,000,000 tons of ice without change in temperature. If this is the amount that the earth receives, think of the amount that must be passing off into space and other planets. This amount has been computed to be 2,200,000,000 times as great as that which the earth receives.

An Exceptionally Large Solar Prominence, 280,000 Miles High, Mar. 25, 1893, by Yerkes Observatory.

. . . AUTOMOBILE NEWS . . .

A NEW IGNITION ALL-SPARK DEVICE.

There is a new device in the auto world that does some remarkable things, according to its makers.



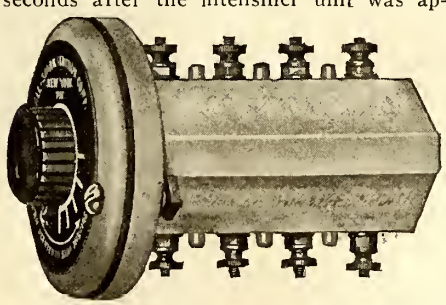
Ford and Other Four Cylinder Cars and Trucks Can Be Improved for All Around Running by the Addition of This New Spark Intensifier Indicated by the Arrow.

The object of this device is to eliminate all spark-plug troubles on Fords and other four-cylinder cars and trucks, and prevent the constant cleaning and buying of new spark plugs.

The most important feature is that it will not be necessary to change plugs on trips—when you want to get somewhere in a hurry, or it is raining and cold—in the middle of the night.

The device can be attached quickly, and only needs an extra set of plug wires run to it; it is placed on the dash panel, as the illustration shows. This device, which may be attached to the dashboard or any convenient place on any car, is really a *spark intensifier*. The device is so designed that the secondary current passing thru it is increased in voltage to such an extent that it will leap across practically any ordinary spark gap.

A great number of government tests were made with this unit installed upon government trucks as well as upon Ford automobiles. The illustration shows this device installed upon a Ford car. The plugs had previously been discarded as worthless, yet by the use of the new spark intensifier unit, the engine functioned perfectly. Shortly after this test a second was conducted in which the crankcase was filled with 23 quarts of oil. Without the unit the engine was run until all the plugs were sooted to such an extent that except for one cylinder, they ceased to fire. Within a few seconds after the intensifier unit was applied, however, the engine functioned properly and continued to do so until the oil in the crankcase fell back to its normal amount.



Close-up of the New All-Spark Intensifier for Four Cylinder Cars—Government Tests Have Shown Its Distinct Efficacy.

ELECTRIC INTAKE HEATER ENDS STARTING TROUBLES.

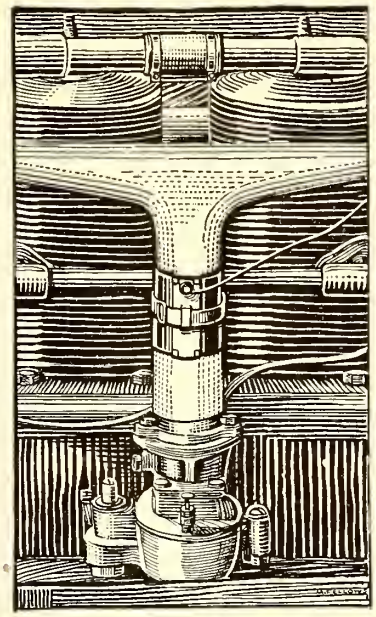
An electric intake heater is the simplest, most logical and surest device offered to automobile owners to assure easy starting of the motor in cold weather. It heats the intake manifold or carburetor by means of an *electric resistance coil*. This heats the air in the pipe and when the throttle is opened the gasoline mixes with the warm air, giving a vapor which ignites immediately.

This electric intake heater will start a motor in *one minute on the coldest day*.

This device can be installed by anyone. It consists of a resistance coil confined in a brass shell which is attached to a brass strap. It is operated from the storage battery by means of an electric wire and is controlled by a button on the dash.

In one minute or less, it heats the intake pipe or carburetor sufficiently to provide a highly combustible mixture which ignites instantly when the motor is turned over. This heater not only makes starting easy, no matter how long the car has stood in the cold, but it overcomes the disadvantage of priming with raw gasoline.

The device also reduces carbon, and most important of all, it saves the battery, as it uses only the same amount of current as the head and tail lights. The intake heater is made for both 6 and 12 volt batteries, single or double wiring system, and can be made to fit any car.

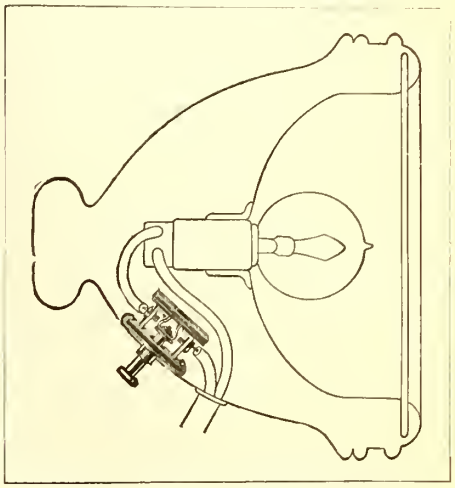


This New Electric Intake Heater Is Claimed to Start the Motor in One Minute on the Coldest Day. It Works on Batteries.

THIS SPOTLIGHT HAS SWITCH.

One of the new developments in auto specialties is a push-and-pull spotlight switch, made for mounting within the shell of a spotlight. Many years' experience in making switches for the automobile trade has proven that such a switch must have large *wiping* contact surfaces to prevent excessive contact resistance, and that the contactor must *float* on the operating shaft, so that vibration and side strain on the button will not cause the lights to flicker.

The insulating parts are made of fiber, the frame of stamped steel, the contacts of brass, and the contactor of phosphor bronze. These parts are riveted together into one solid unit which does not loosen or change alignment when subjected to vibration or strain. The mechanism is not enclosed because this switch is installed inside of the spotlight shell with the button protruding. Either rivets or machine screws can be used to fasten the switch to the shell. No plate is required; drilling one hole the size of the button and two for the rivets or screws permits mounting the switch as shown in the accompanying illustration.



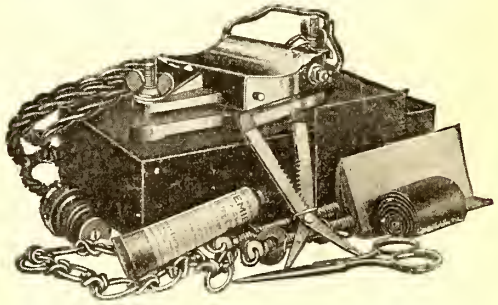
Showing New Electric Spotlight Switch Mounted in Shell of Spotlight, and Wiring Connections.

ELECTRIC VULCANIZER WORKS ON CAR BATTERY.

Never let the little cuts or sand blisters on your tires develop into blowouts. Use an electric vulcanizer like the type here illustrated and repair them. Clean the cut, fill in Para rubber according to directions, apply the vulcanizer and press the red button.

When complete vulcanization takes place, the button automatically "pops" out and the device then cools off. It represents a distinct advance for the motorist in caring for his tire troubles.

This handy little electric vulcanizer, which can be used on casings and tubes, is claimed to be absolutely automatic in operation and connects to battery or lighting circuit. These vulcanizers are furnished to operate either from 110-volt lighting circuit or storage batteries. The standard voltages of the latter type are 6-12-18-30 volts, and when operated direct off the storage battery on your car are positively guaranteed not to damage the battery in the least nor to interfere with its efficiency for starting, lighting or ignition. The 110-volt type will operate from both alternating and direct current. A smaller model of this vulcanizer is made by the same concern which is adapted to repairing tubes only.



Efficient Electric Vulcanizer for Casings and Tubes—It Operates on 110 Volts or Batteries When so Specified.

Legless—He Drives Auto Skilfully

SHOULD you ever be wandering in the streets of New York, or any other large city in the United States, and come across an immense crowd, larger than any ever gathering around an automobile with punctured tires or engine trouble, you will know that the owner of this auto is Mr. Fred Hammel, America's greatest "legless" traveler and autoist. At first one sees absolutely no reason for an immense gathering at a stalled auto. But upon closer inspection it is apparent that even more people might sensibly be gathered there, for Fred Hammel is a cripple. But there is nothing unique in cripples. One sees hundreds of them on the streets of our big cities every day. There is, however, something very unique in Mr. Hammel's skill. His inventive ability coupled with ingenuity have enabled him to build a device by which he can control his automobile, even tho legless from the knees down. To watch him make repairs on the road is a wonderful sight. It seems as tho Dame Nature endowed him with some supernatural ability, inasmuch as he uses his two short legs and his hands, climbing about on all fours with greater ability than we can use our hands and legs. He scrambles over the machine, up at the top of the roof and down again, with the agility of a cat, never missing his foothold or slipping, and at times it seems as tho he is flying in pursuit of his troubles.

A "joy-ride" with him is all that the word implies—and then some. The writer had the opportunity of making a trip thru the crowded streets of New York, across the Brooklyn Bridge to South Brooklyn and back again, being stopt by traffic cops at almost every street crossing, and starting out among the first of those who dart out immediately after the traffic director's whistle blows. Occasionally, some poor fool would step out in front of the machine, and then it seemed as tho one's heart were in his throat, either to swallow it again, or—. But Fred lets his hand glide to the brake lever on his car with absolute calmness, and exerting a slight pressure on this lever causes the car to be brought up to within a few feet of the passer-by. One would think that fifteen or twenty minutes of this kind of excitement would inure one to it. However, this was not the case. Shooting across the Broklyn Bridge at about 45 miles an hour on a down-grade, we suddenly loomed upon an Army truck. Unfortunately, some individuals were working in front of this gigantic truck, when the chauffeur of the truck noticed them almost too late, and jammed on his emergency brakes. About forty feet behind we were sallying forth at 45, and you can just imagine how it must feel for a passenger to be riding on this auto, knowing the chauffeur to be handicapped inasmuch as he cannot apply his feet to the brakes. Again Mr. Hammel's coolness prevailed. With one hand going to the lever, and a pressure ever so gentle, as tho he did not care whether the machine stopt or not, we "fetched" up, so to speak, to within about *five inches* of the truck in front of us. I already saw a smashed radiator and myself being dashed off to the hospital—but not so. The brakes were loosened, and we were on our way again.

Now a word about the machine and its fittings. The photographs clearly depict the appliances used. The three hand levers are of his own design and construction, so adapted that each one controls a distinctive pedal. When it is desired to apply the brakes, it is only necessary to pull its respective hand lever. On the brake lever likewise is a button for the electric horn. On

(*Continued on page* 564)

Without Legs Fred Hammel Drives His Car About the Largest Cities With as Great a Certainty as Any Autoist Possest of All His Limbs. The Hand Levers and Electricity Do the Trick.

Electricity Steers Blind Man

When a young man of Seattle became blinded early in the summer of 1918 he at once set his inventive genius to work to develop an electric direction indicator which would enable him to get about without the use of a cane. As a result of his labors, he holds a patent on a device which not only enables him to get about without a cane, but one that has great possibilities as an aid to navigation on the seas or in the air or as a self-acting course indicator for timber cruisers, surveyors, explorers, prospectors and men who follow similar callings.

The device, as shown in the picture, is attached to the belt of the wearer. It contains two buzzers, wired to points which come in contact with the needle of a specially constructed compass when the wearer digresses from the set course, and indicates the direction to take.

The mechanism is composed of the compass and two buzzers. A signal is given when the wearer deviates from a set course. The signal is the result of a movement of the compass needle when it touches either of the two pins suspended from the cap of the compass, which closes a circuit and rings the buzzer on the side of the course on which the wearer is digressing.

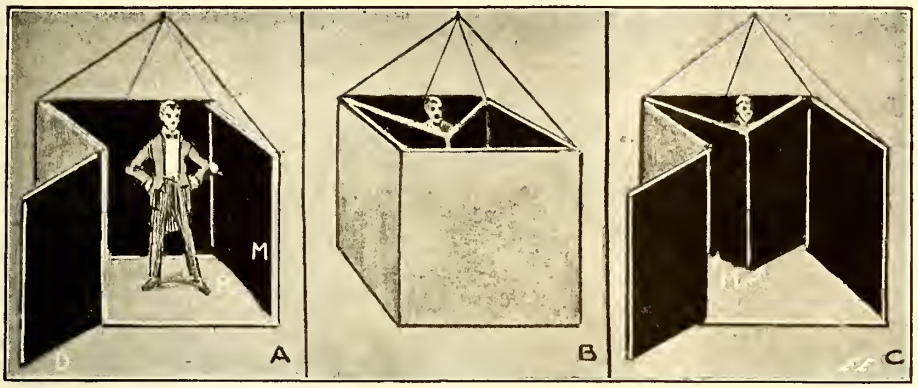
(*Continued on page* 599)

The Electric Direction Indicator, Worn by Its Blind Inventor, Who Developed It to Enable Him to Get About Without a Cane. The Specially Constructed Compass Is Worn in Front. The Two Metal Projections, One on Each Side of the Compass, Are the Buzzers. Clasps at the Sides of the Belt Hold Two Triple Cell Batteries, Which Supply the Current for the Device.

Experiments in Physics

By JOHN J. FURIA, A. M.
DEPARTMENT OF PHYSICS, N. Y. UNIVERSITY

3--Illusions

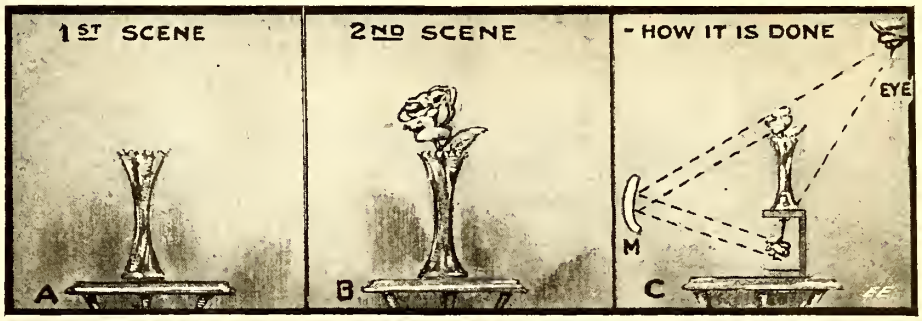


How the "Magic Cabinet" Trick Is Often Performed. First the Person Steps Into the Cabinet at A; the Door Is Closed and the Box Hoisted Up. The Person in the Cabinet Pulls the Two Hinged Mirrors "M" Together; Next the Door Is Opened and—Presto! the Man Has Disappeared—Apparently! Fig. 5.

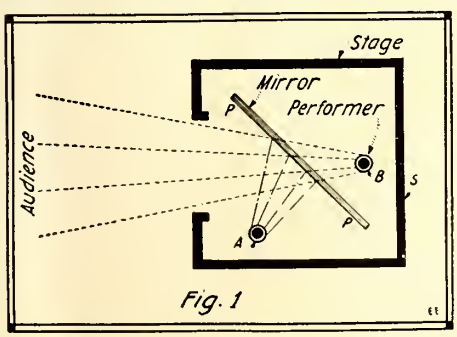
THE optical type of illusion, which is the main type and most elaborate, can be divided into two general classes: (1) The virtual image class, and (2) the real image class. By a *virtual image* we mean an unreal image, one which is caught on a screen. The images we see in the ordinary mirror or "looking glass" are of this type. By a *real image* we mean an image which actually can be touched and caught on the screen. The stereopticon, magic lantern and motion picture machine images are real (caught on the screen). The image formed by a camera lens on the plate or film or ground glass is, of course, a real one. *The eye is capable of seeing both the real and the virtual images,* and this forms the basis of all optical illusions. A plane mirror, highly polished plate glass or other plane surface, always gives a *virtual image.* Because of the possibility of being able to see an actual object thru plate glass and semi-silvered glass, they are almost universally used for feature illusions on the stage.

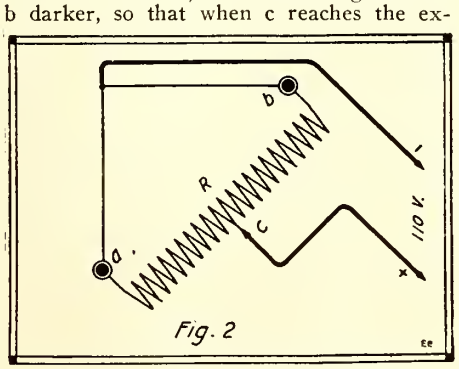
Figure 1 represents the top view of a simple theater stage and illustrates how eminent magicians like Kellar and Thurston made their transformations. The performer stood before the audience while the stage gradually dimmed, and brightened, and lo and behold, the smooth-faced performer changed before the eyes of the audience into a devil. The stage dimmed and brightened again, and the devil was transformed into a skeleton. Then, as an added attraction to the bald-headed first-rowites, the skeleton transformed into a scantily clad chorus girl or a bathing beauty. Finally the audience saw before it, bowing and smiling, in his full-dress suit —the performer. The effect on the audience was immense; the principle and *modus operandi* of the illusion is ridiculously simple. In figure 1, s are the walls of the stage draped in black velvet, p is a piece of highly polished plate glass perpendicular to the floor and arranged at an angle of 45° to the audience. The performer stands at B, in the direct view of the audience. His confederate stands in the wings at A, out of view of the audience. Since the stage is black, neither the performer nor the confederate will be visible *except when illuminated.* A and B are illuminated by a dimming device diagrammed in figure 2. R is a variable high resistance, a and b are lamps connected in parallel illuminating the performer and his confederate at A and B, respectively. As the variable contact is moved to the left, a becomes brighter and b darker, so that when c reaches the extreme left b is practically extinguished. Similarly, as c moves to the right, b becomes brighter and c extinguished. Referring to figure 1 again, when B is illuminated and A dark, the audience sees the performer directly thru the glass. When B becomes dark and A bright, B cannot be seen and A is seen by reflection from the polished surface of the plate glass. Thus as B becomes dark and A light, the performer disappears and changes into a devil (the confederate at A). In the meantime B, being invisible, the performer walks off the stage, makes up as a skeleton and returns to his position. As A is darkened and B brightened, the devil changes into a skeleton. This procedure is followed until finally the performer appears again before his audience to receive his applause. See figure 3.

Figure 4 illustrates the type of illusion making use of the 45° mirror. T represents a revolving table hidden behind the scenery s, P is a good quality mirror placed at an angle of 45° with the vertical. I is the reflected image of the person lying on the revolving table. The person appears suspended in mid-air. If the table is moved along the floor the person appears to move along in mid-air. If the table is revolved the person appears to spin around in mid-air as if pivoted thru his middle. If the person on the table moves his arms or feet the image suspended in mid-air appears to do this also. It is obvious that the person may be made to appear to be flying about, and by interposing a plate-glass tank of clear water in front of the tilted mirror the person appears to be swimming, eating, etc., in the tank of water without having to come up for air. All sorts of variations have been introduced in connection with this simple illusion.



The "Magic Flower Vase." Viewed From a Certain Angle You Apparently See a Flower in the Vase—Can Even Smell it! Advance and Examine the Vase—It's Empty! Figure "C" Explains the "Magic" Paraphernalia. Fig. 6.





How the Magician Changes Into a "Stage Devil" Before Your Very Eyes. His Image as Well as That of His Assistant Can Be Flashed Up Alternately, on the Glass Sheet PP. The Diagram, Fig. 2, Shows the "Dimmer" Used to Switch the Illumination from Image A to Image B, Gradually.

The disappearing cabinet or cage is another of the popular feature stage illusions using tilted mirrors. A man steps into cage or cabinet while the door is open. The cage or cabinet is hoisted up midway between the stage floor and the ceiling. The man shuts the door on himself. The cage or cabinet is let down within a few feet from the floor, the door is opened and the occupant is found missing. The door is closed again, the performer fires a smoky shot. The door is again opened and—presto! the occupant is again seen in the cabinet. One has but to refer to figure 5 to see how simple this illusion is. In figure 5-A P is the performer, M and M are mirrors tight against the sides, D is the door.

(*Continued on page* 572)

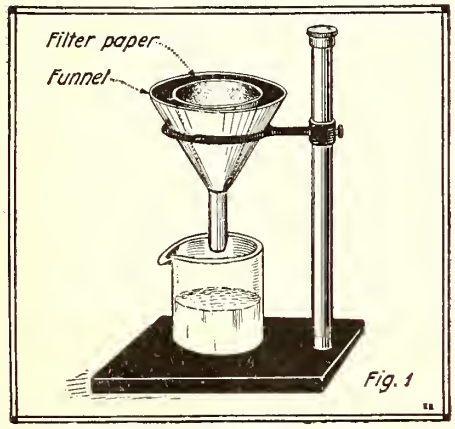
Practical Chemical Experiments

By ALBERT W. WILSDON

Composition of Fruits and Their Food Values.

AT this time of the year, fruits are utilized as a very important part of our daily foods and a little knowledge of their composition and value will not be superfluous. "Fruit" in the restricted sense, includes the pulpy substance enclosing the seeds of various plants, and especially those which are edible in the raw state.

A *green* fruit does not differ very materially from the leaf in composition, but in the process of ripening, under the influence of sunlight, the fruit undergoes a remarkable change in color, texture, composition, and flavor. During this change period it ceases to act on air like a leaf, but to the contrary, *begins to absorb oxygen and liberate carbon dioxid gas.* As the process of ripening goes on, both the *invert sugar and the sucrose increase and the starch and free acid decrease.* Following the disappearance of the starch the sucrose disappears quite rapidly on account of its change to invert sugar. Malic acid appears to decrease, but this phenomenon is largely due to the fact that it is formed

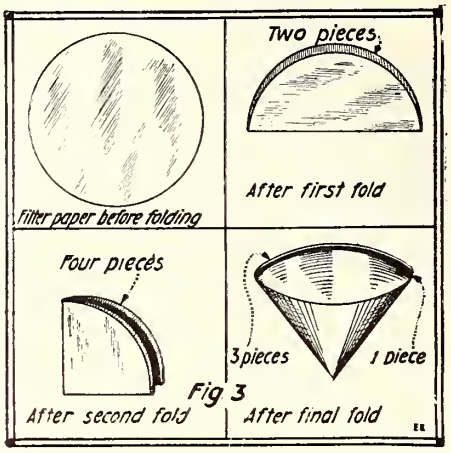


This Form of Filtering Stand May Be Used for All Experiments Requiring Filtering. Fig. 2 Depicts a Convenient Method Which Is Adaptable in Every House.

in the early history of the fruit, and becomes diluted by its growth. It is supposed that while ripening the insoluble pectose changes into pectin and secondary substances of a gelatinous nature. The tannin that made the fruit astringent also disappears. *As the fruit becomes over-ripe, some of the sugar and acid is oxidized, and the fruit in consequence loses its agreeable flavor.* On cold storage this latter condition is deferred, owing to the low temperature, but a very short exposure to air, at ordinary temperature, causes the fruit not only to appear over-ripe, but to decay quite rapidly. Thruout the process of decay, which is assisted by fermentation, carbon dioxid and alcohol are at first formed from the sugar, and later the alcohol is oxidized to acetic acid, and finally in the decayed fruit the seed is set free, ready to start a new plant.

WHAT GIVES TASTES IN FRUITS.

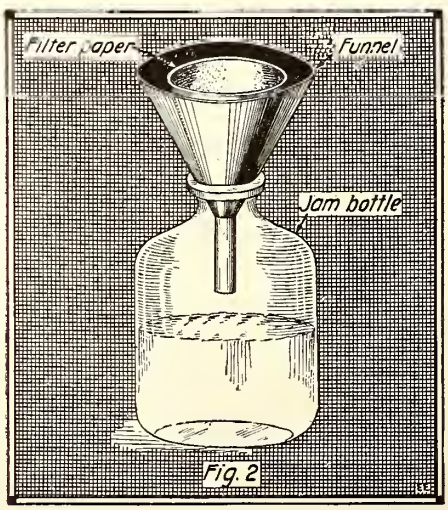
The agreeable tastes possest by fruits are due to the right proportions of the constituents mentioned in the foregoing test, and also to the compound ethers and essential oils which may be present. These flavoring substances are, many of them, present in such small quantities that they are not mentioned in the analysis. Some fruits



Notice that When Finished, the Paper Filter Will Be Conical in Shape and Will Have Three Folds on One Side and One on the Other.

which seem to "melt in the mouth" really do contain considerable soluble matter. It is a well-known fact that sugar disguises acids, and that an agreeable taste in preserved fruits is often due to a judicious mixture of the acid and the sweet. The most important nutritive material in fruits is in the carbohydrate group. Altho starch is present at cetrain stages of growth, sugar is the most abundant of the carbohydrates. This is usually invert sugar, but *apricots, pineapple, and apples contain also cane sugar.* This fact has an important bearing on the dietetic use of fruits, as invert sugar is, in some diseases, as diabetes, more easily assimilated than cane sugar.

The pectus bodies above referred to are not very well understood, but are supposed to be related to the carbohydrates. The insoluble glacto-araban is supposed to give the property of hardness to unripe fruits and vegetables, and is the basis of making jelly. The statement has been made that as the fruit becomes riper the pectose is changed by the action of acids into pectin, a vegetable jelly, which causes the juice, after boiling, to gelatinize when cooled. *This may be noticed in the juice that exudes in the baking of apples.* It is supposed that by boiling too long these



A Clean Ordinary Jam Bottle Will Be Found Efficient as a Filtering Stand When a Funnel Is Used Which Is Sufficiently Large to Rest on the Mouth of the Jam Bottle. If the Stem of the Funnel Is too Long It May Be Cut with a Triangular File.

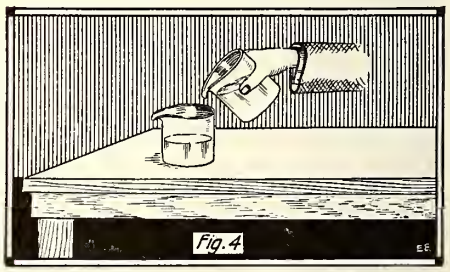
pectous compounds are concentrated into a more soluble modification, and, if this is true, it may serve to explain the fact that sometimes fruit juices that have been boiled for a long time become thick and viscid, but do not form a true jelly. *A partially ripe fruit is better adapted to making* jelly than is one that is fully ripe.

From the foregoing it is evident that pectin bodies are substances of undetermined function very widely distributed in plant tissues. They occur both in soluble and insoluble forms.

In the studies of these bodies the most important problem appears to be the quantitative determination of the pectin bodies occurring in a given tissue, because such a method could be used to determine the function of the material in plants; whether for example, it is a reserve material, a by-product, is used for structural purposes, or has all three functions or two of them; whether the nature of the pectin body changes with the growth of the tissue, or possesses a practically constant composition; whether the pectin bodies obtained from the different sources are identical, are mixtures of the same substances in varying proportions, or are inherently different.

EXPERIMENTS.

Experiment No. 1. To the filtered apple



The Addition of the Various Reagents Mentioned Will Produce the Results Mentioned in the Text. If Possible, It Is Advisable to Use Either Beakers (Lipt) or, if Not Available, Ordinary Drinking Glasses Will Answer the Purpose. These Permit Easier Handling to Those Performing the Experiments.

juice of a ripe apple add an equal bulk of alcohol, and a gelatinous mass consisting largely of pectin will be precipitated. This may be dried, and it will be found that the powder thus obtained is soluble in cold water.

Experiment No. 2. Stew a handful of cranberries, filter the juice, and allow to stand till cold, when an abundant jelly is obtained.

Experiment No. 3. Test some green fruit, a persimmon or banana, for tannin by extracting the juice, filtering, and adding a small quantity of ferric chlorid. The production of a black, or greenish-black, color indicates tannin.

The acidity of fruits is due to the presence of the free acids, Malic, Citric, Tartaric, or their acid salts. They not only have an agreeable acid taste and serve as appetizers, but when oxidized in the body are converted into the corresponding carbonates, and these help to render the blood more alkalin and the urine less acid.

Experiment No. 4. Add to a solution of Malic acid, calcium chlorid, ammonium chlorid, and ammonium hydroxid in excess. There should be no precipitat, but upon adding to this three volumes of alcohol, calcium malate should separate out as a precipitat.

(*Continued on page* 578)

THE CONSTRUCTOR

Making a Machine for Telegraphing Pictures

PART II

By LEROY J. LEISHMAN
Expert in Telephotography

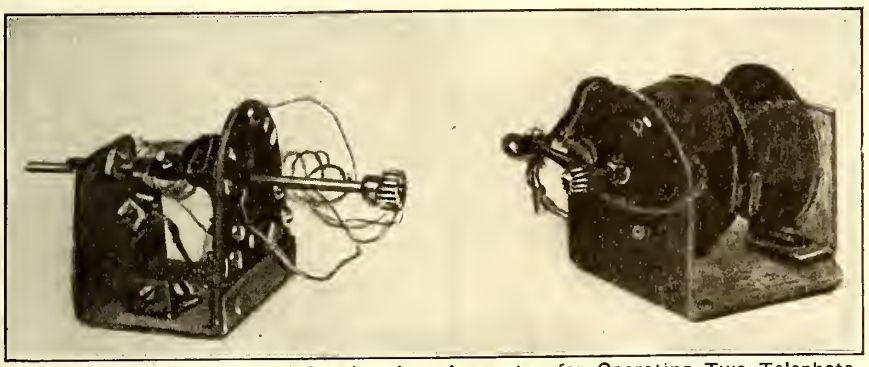


Fig. 3—A Simple Electrical Synchronizer Apparatus for Operating Two Telephotographic Machines. The Commutator of the Motor is Used at the Transmitter and the Motor at the Receiver.

WE can use a rod connection, or one of several different electrical schemes which permit the machines to be operated at long distances away from each other. However, only two electrical synchronizers will be explained. The simplest and least fascinating way to synchronize the machines is by a rod connection H (Fig. 1), with the instruments only a few feet apart. A few rods, such as those used for shafts, can be connected with couplings and one machine placed at each end with the cylinder rods toward you. Make two or more supports for this connecting rod to hold it at the same height as the cylinder shafts, to which it runs at right angles. Place a crown gear I (Fig. 1) or K (Fig. 2) on each cylinder rod, with the teeth turned *toward* you on one machine and *away* from you on the other. Now slip an upright on both ends of the synchronizing rod and place a small gear J (Fig. 1) flush with each end to mesh with the crown gears.

Fix the uprights or supports in place so that the proper connection is maintained and so that both machines run together, regardless of which cylinder is turned. The machines may be operated by a crank attached to the end of one of the cylinder rods, or by a motor properly geared down.

The cylinders themselves must turn at about *one revolution in three seconds.* This may seem quite slow; but it must be remembered that this is a very inexpensive home-made set, and that T. Thorne Baker and Dr. Korn operate their cylinders at only one revolution in two seconds, and that the most delicate sets for one of my systems utilize drums operating as slow as a revolution in one second. Faster work can be done with some of my latest apparatus; but the system is far different from the one for which these machines are used, and the machines are too costly and complex for the average experimenter to build. So let us be content with one revolution in three seconds.

A Simple Electrical Synchronizer.

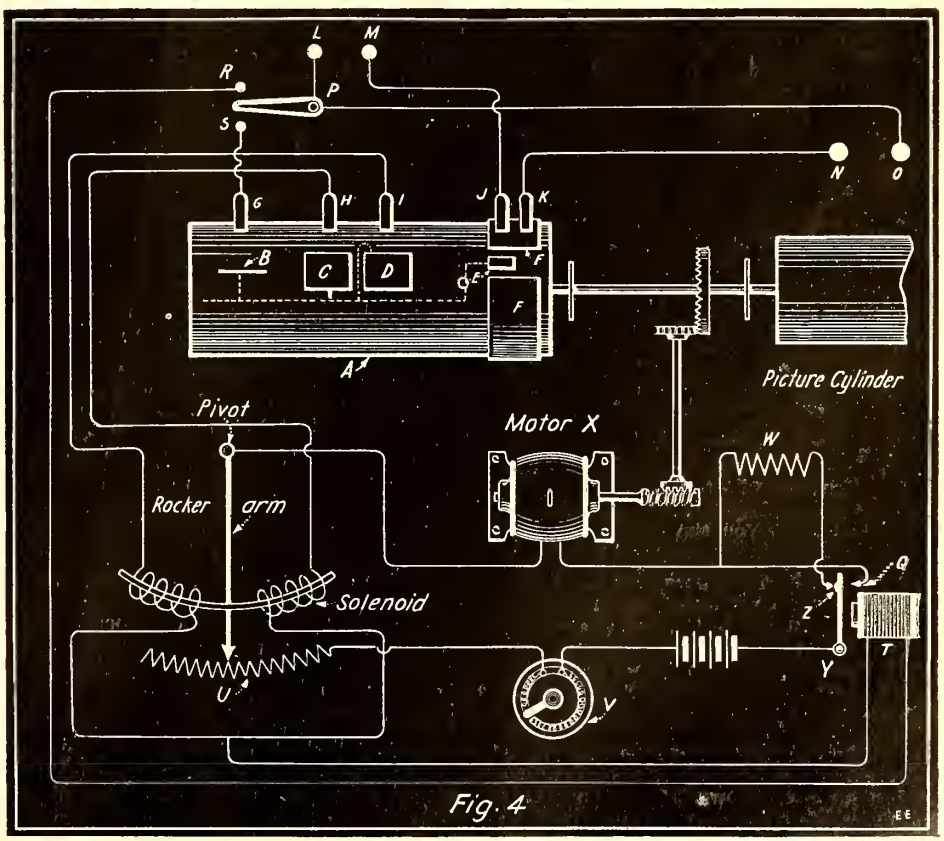
A simple electrical means for synchronizing the two machines utilizes a motor for one machine and its commutator for the other. (See Fig. 3.) The armature of the motor is separately excited and has but two poles; while the field has three poles connected in series, with the connections tapt between the magnets for the three wires which extend to the three segments of the commutator of the other machine. Two diametrically opposite brushes rotate against this commutator and cause the field to rotate in synchronism. The current can be supplied to the brushes by collector rings. As before mentioned, the armature of the motor is separately excited.

The shaft supporting the brushes must be geared (nothing but gearing will do) to the sending machine, and the motor must be geared *in exactly the same manner* to the receiving machine. The sending machine can be operated by hand or by a motor as desired, and the receiving machine will then operate in exact synchronism.

An Automatic Electrical Synchronizer.

The most interesting and ideal synchronizer of all requires no extra wires whatsoever. The principal part is a wooden or other non-conducting drum A (Fig. 4), the shaft of which is connected to the shaft of the cylinder upon which the pictures are sent and received. B is the edge of a piece of metal electrically connected with the shaft. C and D are pieces of graphite connected on opposite sides to metal strips

(*Continued on page* 562)



Layout for Improved Electrical Synchronizer to Be Used for Operating Telephotographic Transmitting and Receiving Apparatus Here Described.

Building and Testing Small Transformers

By J. W. ESHNAUR

BUILDING a small transformer is not a difficult matter if you know the proper sizes and amounts of wire to use and the size and quantity of iron to put in the core. If you do not have this data at hand, you are pretty sure to meet with failure, and in the words of the funny paper ask, "How do they do it?"

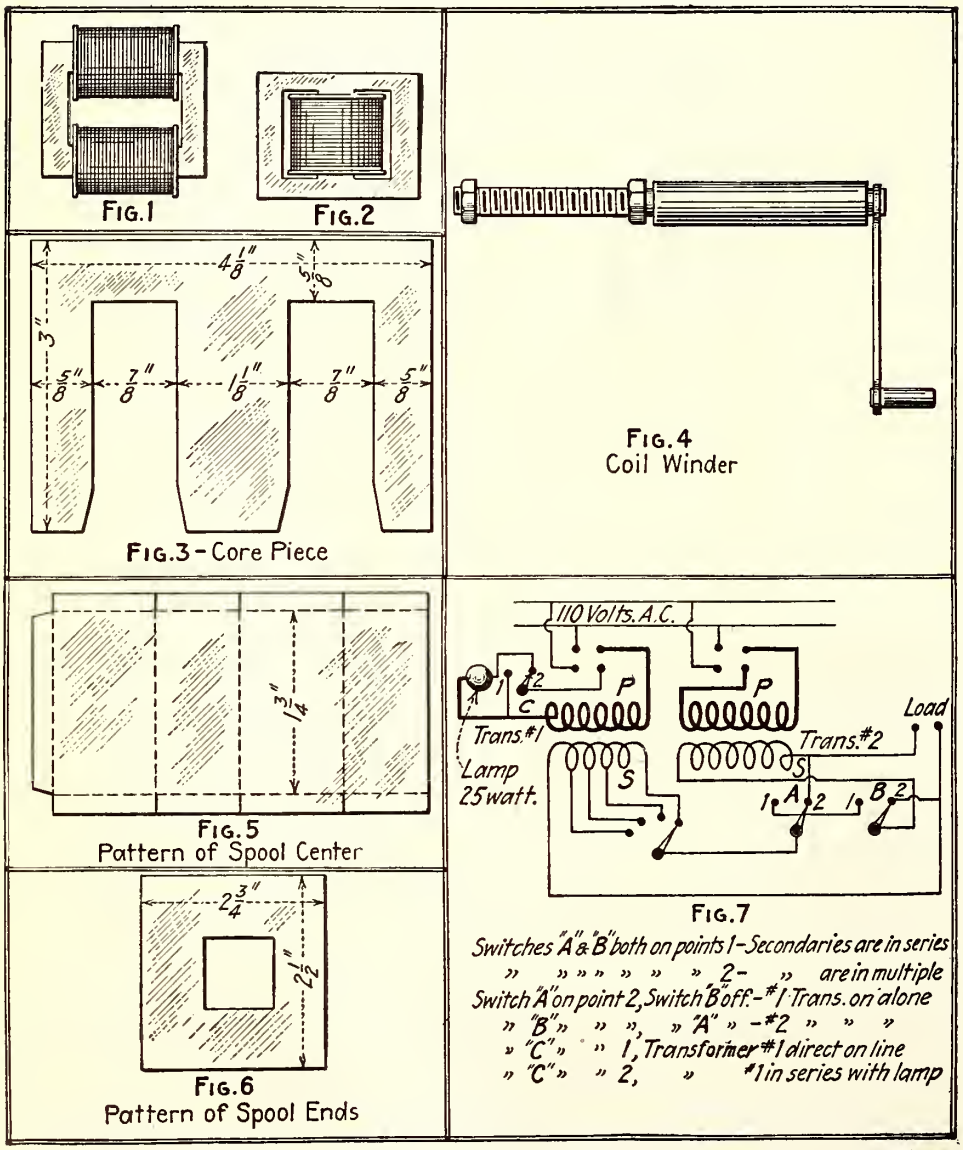
The principal trouble in a small transformer is its tendency to heat *when under no load*. This is caused by losses in the core and Primary winding, the technicalities of which it is not necessary to go into here. Properly constructed, a transformer may remain on the line indefinitely under no load and will not heat. Under a load it will warm up slightly, but excepting on a *dead short* of the Secondary, it will not get dangerously hot.

SHELL AND CORE TYPES.

There are two general types of transformers in use, known as the core type and the shell type, shown respectively in Figs. 1 and 2. The shell type is the easiest to construct and probably the most satisfactory in every way for the Amateur, therefore I will deal with it only. The following instructions are for a transformer to deliver voltages ranging from 2 to 20 volts, but further on I will explain how you may vary the size so as to obtain any voltage you may desire.

BUILDING THE CORES.

First prepare the annealed sheet-iron core pieces. These are made from very soft, thin sheet iron (tin-can stock has been used), and are cut in the shape of the letter E, the dimensions being given in Fig. 3. It is best to make a pattern from some slightly heavier stock being careful to get all parts square and close to size. When the pattern is finished, lay it on the iron to be used for the core pieces and with a sharp scriber mark out a piece. Cut this out, using a sharp cold chisel to cut along the back of the piece between the tongues which cannot be reached with the tinsnips. Lay this piece on the pattern, first one way and then the other, and if the lines all coincide you are all right, if not file the pattern in the spots which are out and try again until the pattern and the core pieces line up pretty close. Now cut enough core pieces to make a pile 7/8" high when tightly comprest. Put all the pieces in a pile with the tongues all in one direction line them up as closely as possible and clamp the back of the E in the vise and file the inside edges smooth. Do the same with the end and middle tongues. You need not file the outside edges unless you so desire, as it is only a matter of looks whether they are smooth or not, but the inside must be quite true or you will have trouble in entering them into the spool.



Here's Something You Have Wanted for a Long Time—Data and Instructions for Building and Testing Small Transformers

WINDING THE COILS.

In order to wind the coils evenly, it is necessary to have some form of winding apparatus. If you have no lathe, you can easily make a winding machine as shown in Fig. 4. A 3/8" bolt about 10" long, with threads cut down about 6"; a piece of 1/4" pipe 1/2" longer than the width of your vise jaws, and a couple of 3/8" nuts are about all that is necessary. Saw the head off the bolt and put on a handle. Slip the pipe on the bolt and run one of the nuts down close to the end of the pipe, leaving just enough end play for the bolt to turn easily. Put the pipe in the vise and this part is ready. Now take a piece of wood, slightly larger in dimensions than the middle tongue of the core piece, and bore a 3/8" hole thru the center lengthwise. Then plane it down taking care to keep the sides as near parallel to the hole as possible, until it is 1/16" larger than the core or 15/16" x 1 3/16".

The spool is made from good, stiff cardboard. Lay out a piece as shown in Fig. 5. Cut on the (solid) lines and bend on the (dotted) lines. It is best to form this part of the spool right on the block you have just finished. The end pieces are shown in Fig. 6. Cut the hole in the center just large enough to fit snugly over the center form. Bend up the short ends and glue them in place. Place the completed spool on the block, slip the block on the spindle of the winding apparatus, lock it in place with a nut, and when the glue is dry you are ready to wind the coils.

THE SECONDARY WINDING.

The secondary winding is put on first. It consists of four layers of No. 18 enameled magnet wire with a tap taken off each layer. Punch a hole in one end of the spool, put the end of the wire thru about 4" and proceed to wind the wire on evenly until the first layer is complete. Cut the wire, leaving about 4" beyond the end of the layer. Punch a hole in the end of the spool and push the wire thru. Put the end of the wire remaining thru the same hole and solder the two together, just outside the spool. Cover the layer of wire on the spool with a layer of paper and wind on the second layer, taking a tap off at the end in the same manner as before, and so on to the end. Number each tap as you take them off and cover the completed secondary with several layers of paper, or, better still, with two layers of Empire cloth (oiled linen).

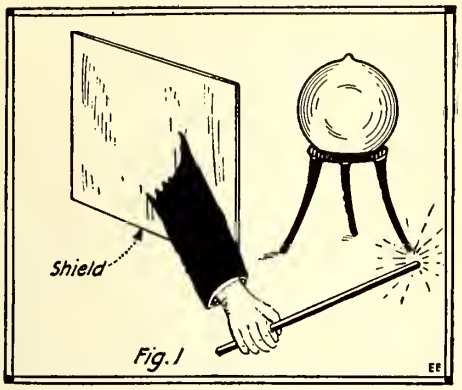
THE PRIMARY.

The primary consists of twelve or fourteen layers of No. 28 enameled or silk-covered magnet wire. Solder a piece of No. 18 wire to the end of the No. 28 wire, make a full turn of the No. 18 around the

(*Continued on page* 580)

Explosions Caused by Light

By H. J. Gray



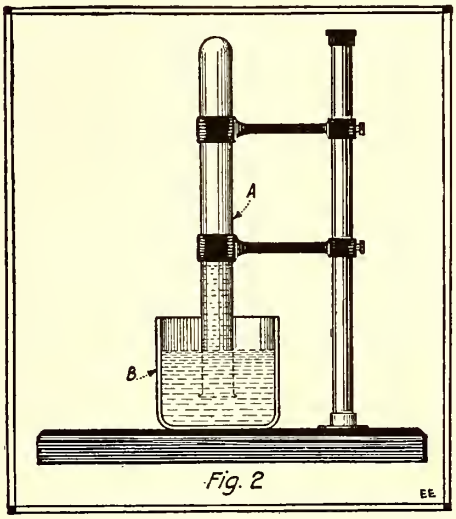
A Mixture of Chlorin and Hydrogen Gases, If Sealed up In a Glass Bulb, Will Combine In Diffused Light to Form Hydrochloric Acid Gas. Exposure to Direct Sunlight or Burning Magnesium Wire Ignites Forcibly the Gas so Formed.

THAT photographs are taken by virtue of the chemical properties of light is a fact that is familiar to everyone, and is indicated by the very word *photography*. But there are many other interesting examples of the action of light in promoting chemical action which have no bearing on the photographic art. Under the influence of the *actinic* rays in sunlight, and the light of magnesium, the electric lamp, etc., elements are made to combine and compounds are decomposed into their elements or broken down into simpler and more stable compounds, while certain of the chemical elements are converted into a different form or allotropic modification.

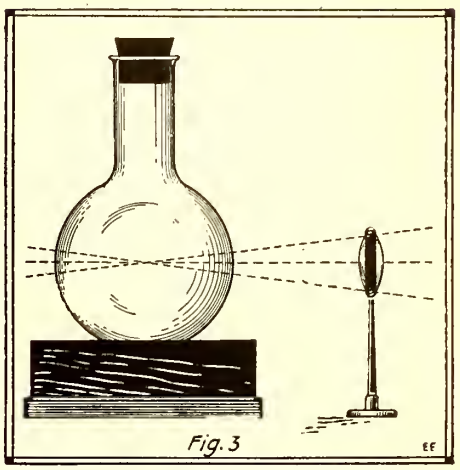
Octahedral sulfur (the form in which native sulfur crystallizes) can be readily dissolved in carbon disulfid. If such a solution is prepared and exposed to a beam of very strong light the clear liquid becomes turbid by formation of insoluble white amorphous sulfur. Yellow phosphorous is also altered by exposure to light.

If a mixture of chlorin and hydrogen gases is sealed up in a glass bulb and exposed to diffused daylight, the gases gradually combine to form hydrochloric acid gas, but the combination does not take place in the dark. Exposure to direct sunlight causes the gases to combine at once with an explosion that shatters the bulb. The same effect is produced by burning a piece of magnesium wire, as in Fig. 1, the experimenter being shielded by a suitable screen.

Another example of chemical synthesis brought about by the action of light is the combination of chlorin and marsh gas (or methan) to form methyl chlorid. Let a tall and wide glass tube, A, Fig. 2, be filled with strong brine and inverted over a vessel, B, containing the same solution, the tube being supported with its mouth beneath the surface of the liquid. One-third of the tube should be filled with chlorin by bubbling the gas thru the brine—in which it is much less soluble than in pure water—and then another third of marsh gas introduced in the same way. The tube must not be exposed to direct sunlight or the gases will combine with explosion but if left in diffused daylight for a few hours the liquid will be found to have risen in the tube which now contains only methyl chlorid. The hydrochloric acid produced at the same time will have been absorbed by the brine, and the resulting vapor will occupy only about one-third the original volume.



The Combination of Chlorin and Marsh Gas Under the Action of Diffused Light, Giving Methyl Chlorid, Which Explodes When Exposed to Direct Sunlight.



The Glass Vessel Contains Sulfur Dioxid Gas. A Strong Electric Light Beam Is Focust on It Thru the Lens Shown, Causing a Mist to Appear and Finally a Fog Which Fills the Bottle. Removing the Light, the Fog Disappears.

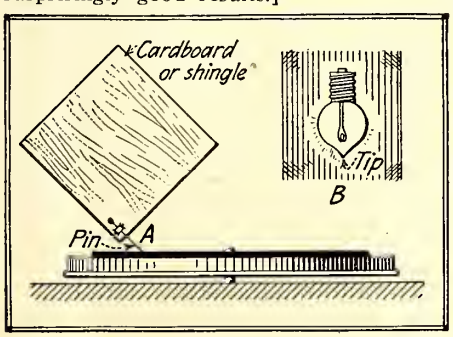
Examples of decomposition by light action are more numerous. Mercurous oxid has to be kept in the dark if required in a laboratory, because it is gradually decomposed by exposure to light, forming mercuric oxid and mercury. Many other metallic salts are similarly reduced by light, hence their use in photography. Those of silver and uranium are particularly sensitive. Glue or gelatine containing a little potassium bichromate is rendered insoluble and leathery by exposure to light, a property that is made use of for rendering glued joints watertight.

If a large clear glass flask is filled with sulfur dioxid gas and closed with a rubber stopper, a further experiment can be made if a strong electric light is available. The light should be concentrated by means of a lens, as shown in Fig. 3, and past thru the flask. In a few moments a mistiness will appear, and after a short time the vessel will appear to be filled with fog. This is caused by the decomposition of sulfur dioxid into sulfur trioxid and sulfur. Upon removing the strong light these products will soon reunite to form the original and invisible sulfur dioxid.

Novel Phonograph Reproducers

Procure a stiff piece of cardboard about 1 foot square and insert a needle into it so as to project from the corner of the cardboard in the fashion illustrated herewith. See Fig. A.

The projecting point is held on the revolving phonograph disc. Best results will be obtained if the cardboard reproducer be held in the fingers where the needle passes thru it. The music is surprisingly clear and can be heard at a distance of 30 feet. [Ed. Note: A wooden shingle gives surprisingly good results.]



Want Some Fun? Try One of These Phonograph Reproducers.

By simply placing the tip of an electric light bulb (see Fig. B) on the disc, the music can be heard about 1 foot away.

Contributed by RUSSELL H. ANDERS.

A SILENT ALARM CLOCK.

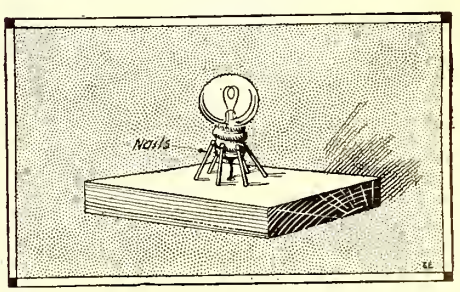
About the most gentle way in which to awaken a person is by the rays of the sun falling on the sleeper. This principle is incorporated in the silent alarm proposed herewith. A nitrogen tungsten lamp of high wattage is mounted within a reflector which is in turn mounted on either the headboard or footboard of the bedstead in an adjustable manner so that the light rays may be focust upon the pillow. This light is controlled by a time-switch or suitable alarm clock arrangement to turn the current on at a predetermined time; the circuit should be opened by a switch located at a point distant from the bed. It is also advised that a good lens be used to increase the strength of beam if necessary. After one is awakened, the flood of light will render the chance of dropping off into further slumber improbable, and you will be persuaded to rise and "douse the glim."

Contributed by J. A. WEAVER.

A Shoe-Nail Receptacle

First procure seven old shoe-nails an inch or so long and a piece of board. Drive six of the nails into the board in the form of a circle, ¾ inch in diameter. In the center of this circle drive the remaining nail, leaving all 7 nails protruding at least ½ inch. Next bend the six nails toward the central one until they will clamp a miniature base lamp. Drive the center nail down until, with the bulb in the improvised clamp, the base will just touch the center nail.

Contributed by E. C. PADDOCK.



Ever Want a Miniature Receptacle in a Hurry? Here's How to Make One From Old Shoe-Nails.

Experimental Mechanics

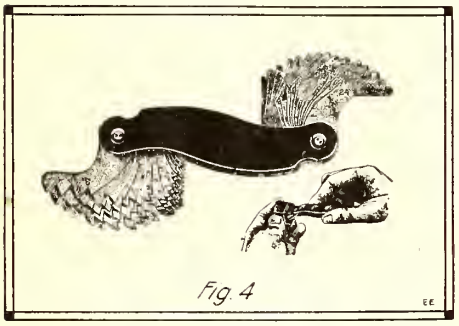
By SAMUEL D. COHEN

LESSON XV

IN the earlier lessons of this Course, the subject of "thread-cutting" was taken fully under discussion; the same being applied, however, to threads cut by means of the lathe only. The lathe is by no means the only method by which threads can be cut, either internally or externally. The most common method of cutting threads in metal or any other materials is by the application of taps and dies. The latter being used for cutting external threads, while the former are used for cutting internal threads.

There are various types of taps and dies that can be used for this work, and these depending upon the character of the work in which the threads are to be cut. The most common thread as obtained from a tap are those of the 60 degree "V" variety. This type of thread is the most commonly used and for this reason it is recommended for the novice. Taps and dies are most easily procured and you will find that very little effort is imposed upon the user of the tool in obtaining an accurately cut thread.

There are three principal types of *taps*, namely:—the *taper*, *plug* and *bottoming*. These three taps are indicated in Figure 1. The *tapering* tap being used for starting the thread, the *plug* tap being used for smoothing the starting thread obtained



To Ascertain the Pitch of the Thread on a Bolt or Nut, a "Thread Gage" of the Type Shown Here is Usually Employed.

by the taper type, and lastly, in finishing a thread, the *bottoming* tap is employed. The latter tap is also used in places where the depth of the hole is limited and it is desired to produce a sharp V-thread in said hole.

The difficulty encountered in attempting to use the bottoming tap first is that it is difficult for the body of the tap to grip the metal. This can be avoided by slightly chamfering the hole and applying a sudden twist on the tap. (See photo Fig. 3.) Should the hole wherein the thread is to be formed be long enough, it is then recommended at all times to use at least the plug tap as a starter, and not a bottoming tap.

It is strongly urged at all times when using a tap that plenty of oil shall be applied to the working surface. Standard commercial machine oil will serve the purpose. In brass, especially when tapping large holes, soluble oil should be applied.

Taps are usually held in *tap wrenches* as indicated in Figure 2. Do not use monkey wrenches or tools that have an L-shaped handle in operating a tap. This is an important rule to be remembered, as when using the latter type handle it is difficult to start the tap into the metal into which the thread is to be cut at exact right-angles to the tap. Often the tap is broken when utilizing such a tool. It is thus clearly seen

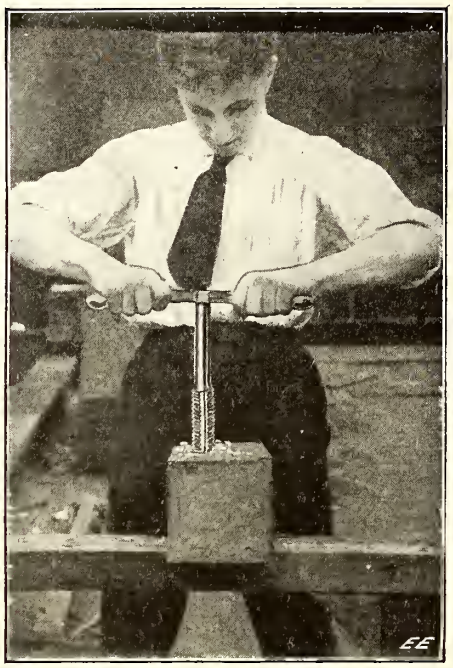
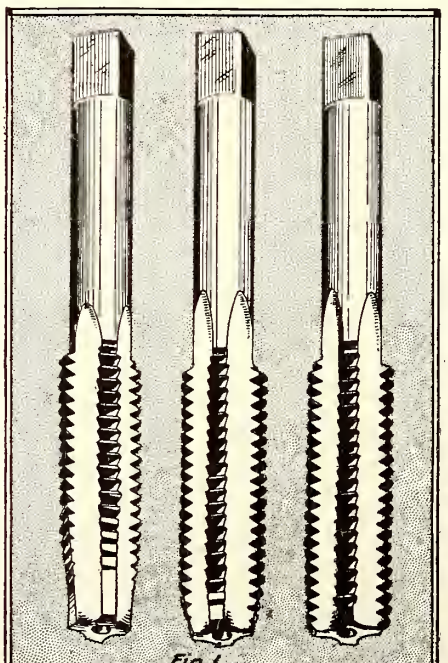


Fig. 3.—Don't Try to Run a Tap in With a Lop-Sided motion, as by Using a Monkey Wrench; Always Use a Balanced, Two-Handle Tap Holder as Here Shown.

the exact reason for using a tool having a T-shaped handle is that the applied force to the tap is uniformly distributed.

The following may be of assistance to the novice as regards lubrication for different materials which are commonly used. As previously mentioned—in brass work, the tap should be lubricated with soluble oil or standard machine oil. Same being applied in tapping bronze.

In copper and aluminum where tapping is most difficult, it is strongly recommended to use kerosene or turpentine as the lubricant.



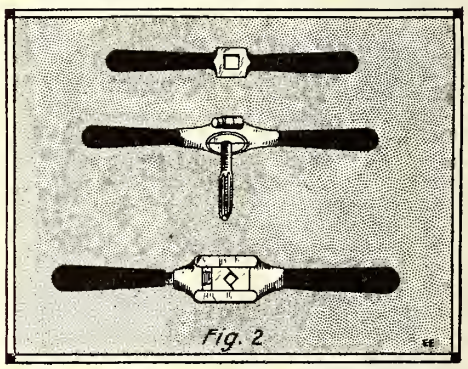
Left—Taper Tap. Center—Plug Tap. Right —Bottoming Tap.

In tapping these materials, it is urged that the tap be given a to-and-fro motion; this being necessary in order to eliminate any possibility of causing the metal to adhere to the tap and thereby preventing binding of the tap. At times it is also recommended to remove the tap from the threaded portion and remove all of the dust particles that may be in the metal and flooding the same with the above-named lubricant, before attempting to proceed with the tapping. Tool and machine steel, especially of the high carbon grade, require standard machine oil as a lubricant while tapping.

The following materials do not require any lubricant for tapping: fiber, bone, bakelite, formica, hard rubber and cast iron.

Miscellaneous Notes on Tapping.

All threading of machine parts and castings is not done by means of the standard tap wrench by hand, but in some cases the threading is done in a *drill press* or in a *lathe*. In machine shop practise large holes often have to be tapt measuring two inches or more in diameter. It is manifestly impossible, or at least impractical, to attempt to tap such a hole by hand, altho it is sometimes done in an emergency. For such a job, the first point to be watched should be



Three Common Forms of Tap Wrench Used in Machine Shop Practise.

to get the tap firmly over the opening, the edge of the hole being eased off a little with a file if necessary to start the tap. It is a common trick in tapping holes such as this to place the part or casting on the table of a large drill press and center it so that the spindle of the press comes directly over the hole to be threaded. The tap is then placed in a position over the hole and the spindle either fitted with a chuck to hold the tap, or in some cases the spindle simply carries a tapered *center* which presses against the center hole in the end of the tap. By throwing in the back-gear of the drill press, any pressure desired can be obtained on the tap and under these conditions the tap is threaded into the material by turning it slowly with a large wrench; in the case where the person doing the tapping is sufficiently skilled the tap can be held in the drill press chuck, and by throwing in the compound back-gear so as to cause the spindle and tap to just barely turn, the hole is thus tapt out. By throwing the reverse lever on the drill press, the tap can be *backed out* when the tap has been threaded thru the hole a sufficient distance. The "feed" is worked by hand.

Many small parts and castings, etc., are easily and accurately tapt in the lathe.

(*Continued from page* 579)

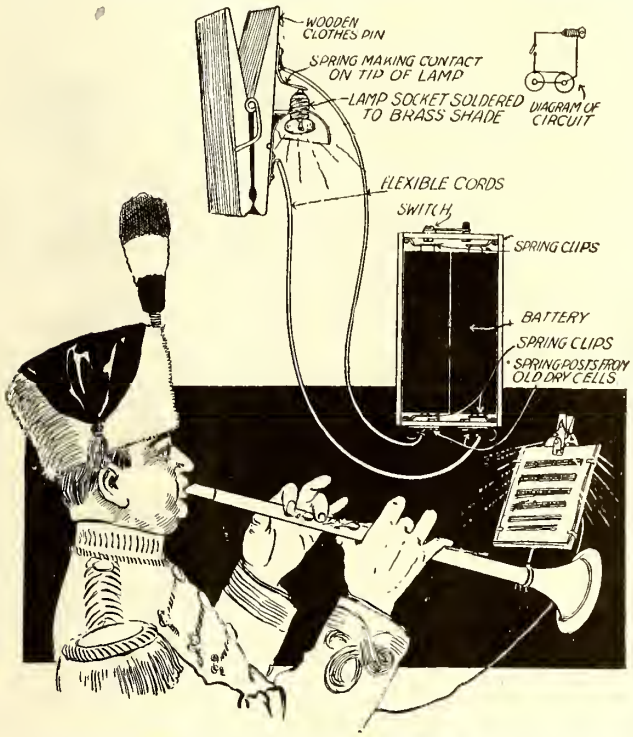
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

MARCHING LIGHT FOR MUSICIANS.

Herewith is a sketch of a Novel Musicians' Light for musicians when marching at night. I have used one for some time and find it very satisfactory. The description follows:



An Electric Light of Many Uses—Here Shown Lighting up the Bandsman's Music.

The box is made of a cigar box or other light wood, of a size to accommodate two flashlight batteries of the type you desire to use, and may be provided with a hinged cover to facilitate replacing the batteries. One end of the box is provided with a small lever switch for opening and closing the circuit. The other end is equipt with two spring clips taken from old batteries.

Secure a piece of brass and bend it in a semi-circle with a projection on one side to be fastened to the wooden clothes pin as shown in the sketch. A lamp socket from an old flashlight is placed thru a hole made in the top of the shade and soldered. Over this is placed a flat bent spring, secured to the clothes pin with small wood screws, and close enough to the socket as to make a firm contact with the lamp when screwed into the socket.

The flexible cords should be of sufficient length to reach from a convenient pocket, in which the batteries will be carried, to the music lyre on the instrument.

The batteries are connected in multiple or parallel to give longer ampere-hour capacity.

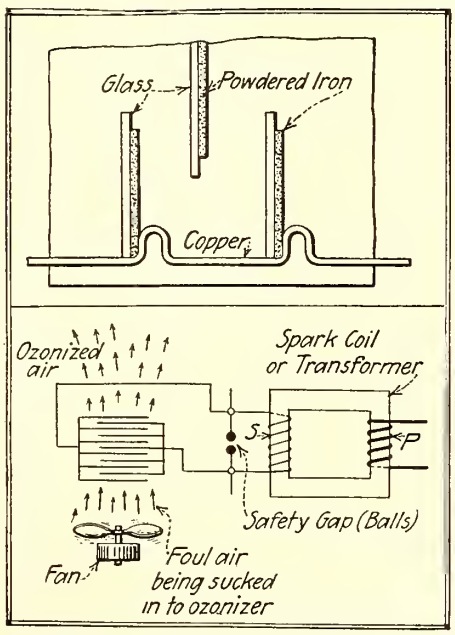
Contributed by A. L. AVERY.

SECOND PRIZE, $2.00

OZONE AND ULTRA-VIOLET RAYS FOR PURIFYING THE AIR.

The many uses for ozonized air makes its production in quantity of growing importance, and apparatus suitable for such work is of increasing interest. A convenient design for apparatus of this nature is shown herewith and consists essentially of glass plates, covered with powdered iron, and fixt alternately to the top and bottom of a suitable receptacle. To make the iron adhere properly it may be mixed with shellac and applied in a thin layer. The glass plates come into contact with copper conductors both at the top and bottom of the receptacle, and a brush discharge of electricity will take place between the two sets when the conductors are connected with the secondary of a spark coil or transformer, giving at least 6,000 to 7,000 volts. Air is forced thru the receptacle by means of a blower, and the air currents will take a zigzag course around the ends of the plates, thus coming into intimate contact with the discharging current.

Contributed by HAROLD C. RIDGELY.



A Home-Made Ozone and Ultra-Violet Ray Generator for Purifying the Air.

THIRD PRIZE, $1.00

AN ODD "SPARK" PHOTO.

The accompanying photograph represents a spark picture which can be easily duplicated with interesting results by any electrical experimenter who possesses a small spark coil, or static machine and Leyden jar. This picture which was contributed by Mr. C. J. Forrest of Blenheim, N. Z., shows a "New Zealand Highlander" in full regalia, and was taken in the following manner:

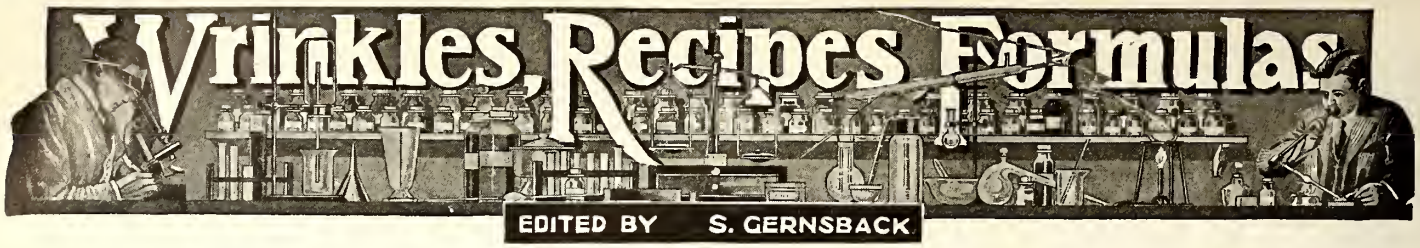
This Odd "Spark" Photo Was Made by One of Our New Zealand Readers. It Represents a New Zealand "Highlander" and Was Obtained by Passing a Spark From an Electro Thru a Photo Plate, to a Tin-Foil Sheet.

The odd results shown were obtained by placing an old postcard block (printing block) on the film side of a photographic plate, and then placing a piece of metal underneath the plate. The metal block bearing the image was connected to the outside coating of one Leyden jar on a small static machine, while the piece of metal below the photograph plate was connected to the outside coat of the other Leyden jar on the machine. The handle of the static machine was then turned and a spark allowed to jump between the discharging knobs. The photo plate was then developed in the usual manner with the results here shown.

HASTENING ACTION OF NITRIC ACID ON COPPER.

To hasten the action of nitric acid on copper, drop a minute amount of sodium carbonate in the acid. This is especially good when the acid is too weak to readily decompose the copper.

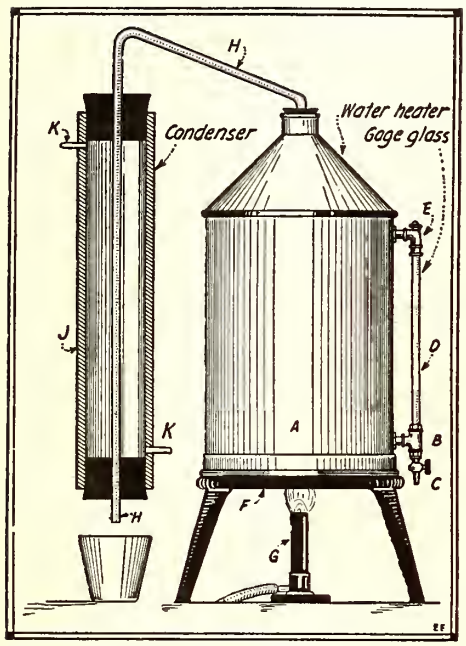
Contributed by BENSON FREEMAN.



LABORATORY HOT WATER SUPPLY.

By H. J. Gray.

A supply of hot water is a great convenience in the laboratory or workshop, and while a tin kettle and a gas ring will serve very well as a makeshift, it is not a difficult matter to fit up a more serviceable installation. The arrangement illustrated was constructed by the writer for



Distilled Hot Water Any Time You Want It. It's Easy With This Laboratory Hot Water Heater, Which Anyone Can Make With a Little Ingenuity.

use in a small private laboratory. The water is heated in a large oil can, A, which should be the largest obtainable. Near the bottom a brass T gas-pipe fitting, B, is soldered into a hole made to receive it. A small brass tap, C, is screwed into the lower arm of the T, while the other supports a length of glass tube, D, the other end of which is fitted into a brass elbow joint, E, near the top of the can. The glass tube forms a gage to indicate the depth of water within the can. It can be fixt like the water gage in a model boiler. In fact, instead of using gas fittings the necessary parts may be obtained from a dealer in model engineers' sundries if preferred. The gas fittings with a glass tube fixt by means of leather packing, with a piece of thick indiarubber tube to cover the joint outside, make a good substitute for a time. The can is supported on a strong iron stand with a piece of asbestos millboard, F, beneath it to protect the bottom from the flare of a Bunsen burner, G, used as a source of heat.

In order to utilize the escaping steam a condenser was fitted to the side, as shown. This consists of a bent glass tube, H, passing thru a hole made in a sound cork closing the mouth of the oil can, so as to just reach inside. The lower part of this tube is cooled by water circulating thru a wider tube, J, which has a waxed cork at both ends and two side tubes, K K. Cold water enters thru the lower side tube and escapes from the upper one, indiarubber tubes being used to make the necessary connection with a full pail placed above the condenser and an empty one on the floor. The boiler may be filled by siphon action so as not to disturb the condenser fittings by removing the cork. Simply connect an indiarubber tube to the tap, drop the other end in a pail of water standing at a higher level, and suck a little air out from the end of the condenser tube to start the siphon. The water which falls from the end of the condenser tube is preserved as distilled water—always a useful thing to have in a laboratory. Of course the longer the water is allowed to boil the greater the quantity of distilled water formed.

WAX THE CORKS—IT PAYS.

Corks can be made quite air- and water-tight by dipping for a second or two in melted paraffin wax heated in a tin over a spirit lamp. The wax should not be made too hot or it swells the corks unpleasantly and also becomes deteriorated.

When chemicals are put away for a considerable time, and in cases in which they are liable to deteriorate by contact with the air a seal of paraffin wax will form a simple and efficient safeguard. Keep the wax in a shallow tin—the lid of a blacking tin will do very nicely when cleaned—and melt by gently heating over a spirit lamp. Cut the cork flush with the top of the bottle and dip momentarily into the molten wax. The writer has stored even very deliquescent substances for many months in this way without a trace of moisture appearing.

PEROXID FOR ACETYLENE LAMPS

A little peroxid of hydrogen—the stuff ladies use for making the hair golden—works wonders in an acetylene lamp. About a teaspoonful added to the water in the generator causes a marked increase in the brilliance of the light, and is in no way detrimental to the metal parts of the apparatus.

SAWING BOLTS AND SCREWS.

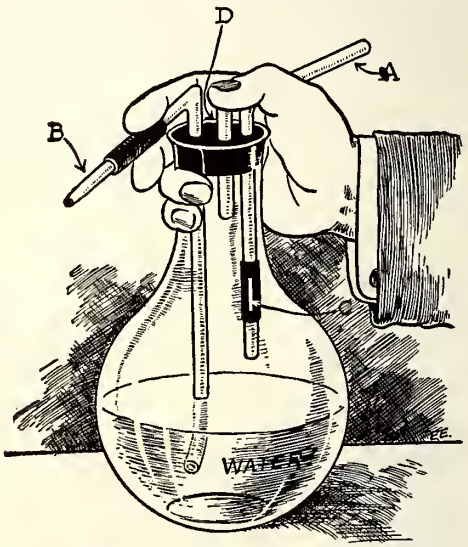
It is sometimes necessary to trim the end of a bolt, or to remove a portion in order to shorten it. In such cases it is a good plan to keep a nut some distance up the bolt, finally running it off to remove any burr left by the saw. Otherwise there is usually some difficulty in starting a new nut, and the threads may sustain permanent injury as a result of the attempt to force a nut over the end.

SHOT FOR CLEANING BOTTLES.

A method of removing obstinate stains from bottles that is often recommended is to pour in some water and small shot and shake until the bottle is clean. This, it is true, removes the dirt, but it generally leaves behind some streaks and particles of lead adhering to the glass which can be distinctly seen in a good light. For chemical and photographic purposes the lead is as bad or worse than the dirt, and must be completely removed before the bottle is used for storing solutions. A little nitric acid should be kept for this purpose, diluted with an equal bulk of water. A good rinse with the acid will dissolve all traces of lead, after which the bottle can be washed in the ordinary way. The acid may be used repeatedly.

A HANDY LABORATORY WASH-BOTTLE

The continuous flow wash-bottle shown in the accompanying sketch will be readily appreciated by those who have used the old type wash-bottle requiring constant blowing. It is simple and effective and should be a valuable asset to every laboratory. It is composed of a flask, stopper and three



We Have Seen Many Types of Laboratory Wash Bottles, But This is an Ideal One—Simple to Use and Easily Made.

tubes, B, D and A; B being the outlet, D for releasing the pressure and A for blowing. Slipt over the lower end of tube, A, is a short section of the rubber tubing with a small stopper inserted at the free end. A slit is then cut into the rubber tubing, as shown at C. This has the effect of a check valve, allowing air to pass thru the slit C, in only one direction, that being into the bottle.

In operating, the flask is held in the right hand with the outlet tube between the index and second fingers and the thumb over the tube D. It is then ready for blowing, which is done in the regular way thru the tube A. The air passes thru the valve, thereby setting up a pressure in the bottle which causes the emission of water from the outlet. The flow from the bottle will then continue until the pressure is relieved by the displacement of the water. As it is possible to create approximately 2 pounds pressure in one blow, considerable water is ejected before the pressure is exhausted and the flow stops. Should it be necessary to stop the flow instantly, or before it would do so by itself remove the thumb from the tube D.

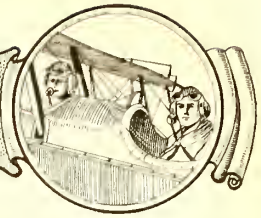
Contributed by RUDOLPH C. LANG.

NON-FERROUS MAGNETIC ALLOY.

Though manganese itself is only feebly magnetic, while copper and aluminium are destitute of magnetic properties, an alloy of these three metals is found to possess magnetic properties comparable with those of cast iron. The alloy in question contains 60 per cent copper, 26 per cent manganese, and 14 per cent aluminium.

Contributed by H. J. GRAY.

RADIO DEPARTMENT



The Submarine's Under-water Radio

IN a general way it is known that during the war a method was found to communicate with a submerged submarine from shore or sea. How this is done and how it came to be discovered that it could be done not until now has been made public. Like a good many other revelations it came when the researchers were at work on another problem.

The scientists of the radio section of the Bureau of Standards stumbled on the secret and the lucky ones to suspect it were two young assistants not long out of high school. Their experiments and the development of what is known as the "loop aerial" for submarine radio communication by the bureau, resulted in a device so simple and perfect, and producing such wonderful results, that the navy has adopted it and is equipping all its undersea craft with this style of loop.

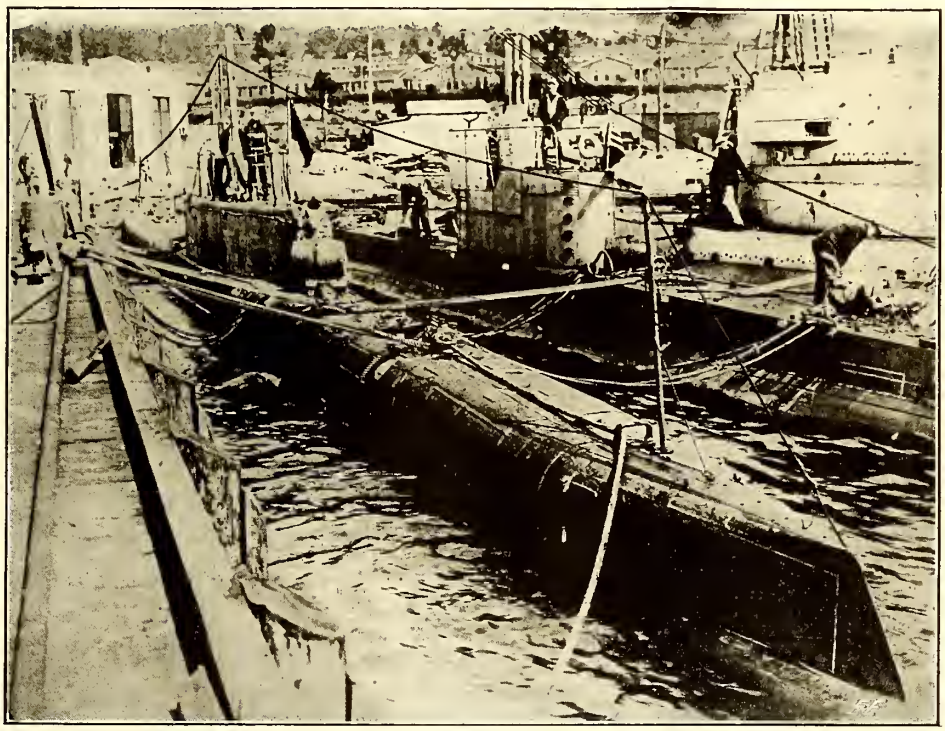
In the fall of 1917 a series of experiments was undertaken by the bureau to develop an apparatus for the detection of enemy submersibles. Mr. J. A. Willoughby and Mr. P. D. Lowell were engaged in the work. They had a notion that a closed "loop" or rubber encased coil of wire offered the best chances for success. They made one and threw it one night into a tank of fresh water on the grounds of the bureau near Chevy Chase, Md., a suburb of Washington. To their delight they received a signal from the big radio station at Arlington. The next night they submerged the coil in the tidal basin of the Potomac near the new Navy Building. Again the signal came with no difference in strength whether the loop or coil was suspended in air or sunk in the river.

DISCOVERY OF THE "LOOP'S" EFFICIENCY.

The significance of this discovery struck both young men. Here was a way possibly to detect the presence of enemy submarines, but surely to talk with our own, which was equally important, had been thought impossible. This was in November.

In December improvements in the submerged coil brought the reception of signals from Lyons, France; Paris and San Diego, Cal. By March last year excellent signals were received on a single turn coil 150 feet long by sixty feet high having a wave length range of 100 meters to 15,000 meters. Experiments continued.

In April Mr. Willoughby discust with Lieutenant Commander H. P. St. Clair, of the Radio Division of the Navy, the use of "loops" on submarines for both transmission and reception under water. Both he and Mr. Lowell were sent to New London to work under Commander McDowell in charge of the base, to install the apparatus for a try out on submarine D-1. It is a simple contrivance, the metal frame of the submarine itself being a part of it, this being used as a "ground" just as the earth is used in land telegraphy. The circuit is thus made complete. As finally perfected the loop consists of two insulated wires grounded at the extreme ends of the hull carried over suitable supports to the conning tower and thence thru "radio-lead-ins" down into the boat to the receiving and sending apparatus.



Equipping U. S. Submarines with New Under-water Radio Antenna. The Antenna Comprises the Single, Heavily Insulated Wire Passing from Bow to Stern, Over the Conning Tower. Messages Have Been Received 6,000 Miles When the Loop Was Submerged 8 Feet.

SUBMARINE USED AS "GROUND."

A new type of loop was tried on the U. S. S. G-3, in which the lead-in wires were brought in from the upper side of the "loop" instead of the lower and the entire loop was insulated from the hull. Better, but not satisfactory, results were obtained. Up to this time the frame of the boat had not been used as a "ground."

The lower side of the "loop" was removed and the ends of the wire fastened to the bow and stern. The top of the "loop" was submerged eight feet; *signals from Nauen, Germany, were clearly heard.* Very sharp indications of direction were obtained when under water or on top of it. And soon other stations were heard, including *Carnarvon, England, Rome, Italy, and various merchant vessels.* Later experiments showed that communications can be carried on at sea under all conditions more efficiently with the closed "loop" aerial than with the ordinary elevated antenna.

To receive short wave lengths the loop must be near the surface of the water, whereas a wave length of 10,000 meters can be received at a depth of twenty-one feet. Still longer lengths can be heard at greater depths.

TRANSMISSION UNDER WATER.

Signals can be transmitted from the loop to a distance of *ten or twelve miles* when the submarine is completely submerged, the maximum distance being obtained when the top of the "loop" is practically at the surface. The distance decreases to two or three miles when the loop is eight or nine feet below the surface. Submergence of the boat during the reception of or transmission of a message does not alter the wave length. If the maximum depth for the wave length being used is exceeded, communication is then interrupted.

The report of the Bureau of Steam Engineering of the Navy Department in its summary of underwater radio experiments says:—

(*Continued on page* 560)

The Wireless Ukulele

The accompanying pen and ink sketch by our friend, Emerson Easterling, sure does bring back the golden memories of the good old "Amateur Radio" days. Just imagine, friends and fellow citizens, what a wonderful mental exhilaration it is to slip on the "cans" and hear the wireless telephone hum the strains of the Hawaiian ukulele, as played by the natives on the moonlit beach of far-away Wakakai. Oh boy! that sure is the life, and it doesn't require any excessive strain of the mental fibres of your cerebrum and cerebellum to picture the fair Hawaiian maidens dancing the Hula Hula to the tantalizing strains of the Hawaiian Elite orchestra. All this and more does the wireless amateur enjoy at some time in his glorious and educational career, but if Secretary of the Navy Daniels has his way there "ain't agoin' to be no sech animal" as a Radio Amateur from Portland, Maine, to the "Barbary Coast." No siree. In onion—we mean "union," there is strength. So get together, fellow Radio-bugs, and think up all the good arguments and good deeds you can about Amateur Radiodom. Talk about it at your radio club meetings.

The "Radio-Bug" Has it on All of Us—He May Put on the "Cans" and Listen to the Ukuleles Strumming Gaily in Far-off Hawaii, and With a Little Imagination—Well Say, Who Couldn't See the "Hula Hula" Maidens Dancing in All Their Native Charm?

Unique Radiophone Helmet

Photo Underwood & Underwood

The Radio Telephone Apparatus Worn by an Airplane Pilot in the Recent Successful Experiments With This Wonderful Voice-Transmitting Wireless.

Recently Secretary of the Navy Daniels spoke by wireless telephone with a naval seaplane in flight, 150 miles away from Washington, where the apparatus was located which Secretary Daniels used in talking to the plane.

The accompanying photograph shows the interesting radio telephone receiving helmet used by aviators, and which effectively cuts out all extraneous sounds and noises, including that from the airplane engine. These helmets are made of rubber and leather, and the telephone receivers are mounted in the best quality sponge rubber in such a way as to effectually prevent the transmission of sound, even thru the bones of the head.

The wireless telephone conversation held with Ensign Harry Sadenwater, while flying at a distance of 150 miles from Washintgon, when Secretary Daniels asked him *via radio* what kind of a flight he was having, constituted a new record in the field of Airplane Radio-telephony.

The microphone is of a new type and is open back and front, so that the air waves in front are balanced by those in the back. The engine noises are thus nullified and only the voice air waves are effective in vibrating the diafram of the microphone.

A FOOL THERE WAS.

(With apologies to Kipling)

A FOOL there was, who a wireless made,
Even as you and I.
Two coils of wire together he laid,
With the bill at the junk shop still unpaid,
Tho he called his father's purse to his aid,
Even as you and I.

Oh, the years he'd waste and the tears he'd waste,
And the work of his head and hand
Belong to the science he did not know,
And now we know that he never will know,
And never will understand.

A Fool there was and his coin he spent,
Even as you and I.
The money that should have gone for rent
He paid for receivers. for he was bent
To pull from the skies a radio sent
Even as you and I.

Oh! the news he'd get, and the use he'd get
From this instrument he had planned;
But his scheme didn't work, he didn't know why,
And now we know he never knew why,
And never did understand.

He sent a wave as broad as a car
Even as you and I,
Which even Fessenden couldn't bar,
His coil was large and the spark went far,
And mixed with a message for N.A.R.,
Even as you and I.

And it wasn't the kale, and it wasn't the jail
That filled his soul with despair,
But 'twas the losing the set
That he'd famished to get,
For he'd violated the "laws of the air."

By—
Osborne Anderson,
Ernest A. Innes.

HOW RADIO IN THE CLOUDS FOILED THE GERMANS.

Sounds real mystical, doesn't it, radio in the clouds? And it proved just as mystical as it sounds for a long, long time to many hapless German aviators, and other wearers of the ex-Kaiser's iron cross. Airplane radio among the clouds was finally worked out into a regular melodrama by the Yankee wireless experts and fliers in France. It usually required two Allied airplanes at least to play this game, and the villain Hun aviator was invariably brought to justice sooner or later, once the stage had been set.

The setting was arranged in the following manner: An Allied aviator would rise from the ground and fly toward the rear of his own lines, so as to secretly gain a high altitude, and he would then return toward the front, flying so high as to be almost invisible. Presently another Allied flier would join him. Then the trap would be set for the German flier, or fliers. One of the planes would rise above the clouds and hover in a certain locality, out of sight, while the other plane would remain fully exposed, and in some cases even drop to a lower altitude so as to be more visible to the enemy. It would not be long before a German flier would be seen sneaking up in an effort to surprise the Yank. But here is where modern science, in the rôle of wireless telephony, which was so wonderfully developed by the American Signal Corps during the war, is to step in. The aviator watching for the German signals his approach and his position to his fellow aviator hiding above or in the clouds, by a wireless telephone message. At the critical moment the final information is given by radiophone to the hidden flier, and he pounces out of the clouds on the German, who often leads him a merry chase, but our second flier who had been on the watch joined in, so that it was a case of two to one. Sometimes there were several German planes, and then it often happened that two or three Allied fliers had to battle with an equal, or even double and triple number.

See Col. 2 Par. 14 for next page.

Radio Problems in Aviation

By EDWARD RICE DOYLE

Former Radio Officer, Air Service, U.S.A.

THE day is not far distant when all airplanes used in long distance flights will be required to carry standard *wireless equipment*, permitting of communication over distances equal, if not greater, than the ranges of sets required on passenger steamship liners. The reason is obvious. An airplane in distress is far more helpless than a ship and in case of forced landing, relief is almost always an immediate necessity.

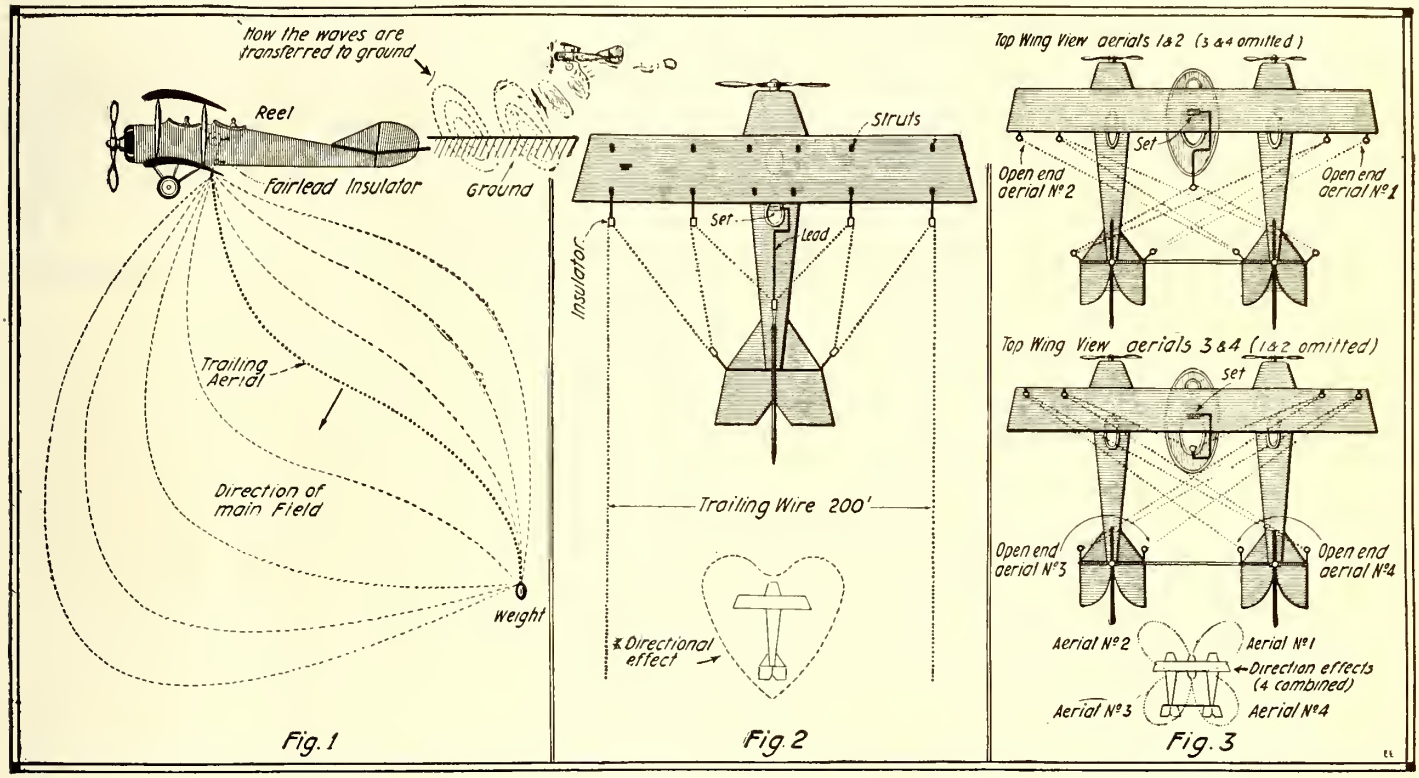


Fig. 1—This Illustrates the Simple Trailing Type of Airplane Radio Antenna, Used to a Great Extent During the War. It Can Be Reeled Up Quickly But Possesses Several Disadvantages. Fig. 2—A "W" Type, Combined Fixt and Trailing Radio Antenna, Successfully Used for Inter-plane Communication. Top View. Fig. 3—Radio Antenna Rig-up Proposed By the Author, for Double Fuselage Biplane. The Quadruple Antenna and Its Directional Effects Are Clearly Illustrated.

Even in cross-country flying a good radio outfit is a necessity in holding a true course and in signaling ahead for special parts or supplies to save time at intermediate landing points *en route*.

The requirements for a reliable radio apparatus on airplanes bring up certain problems which are still unsolved and subject to considerable experiment at this date, when American ingenuity has been able to advertise its achievements in airplane radio. These intensive problems will attract the highest radio engineering skill in their solution.

The problems may be considered as:

1. Directional control of transmitted signals.

2. Wave length adjustment of incoming and outgoing signals.

3. Transmitting ranges and sensitivity of receiving apparatus.

Under the first item, that of directional control, the engineer faces a very difficult task. The design of the aërial has always been the critical factor in directional control, and it is greatly limited by the facilities which an airplane offers for setting up the antenna.

The most effective control has been secured by the single trailing wire antenna. (See Fig. 1.)

A length of about 300 feet of wire is allowed to swing in the air held down partly by a weighted "fish." Thus the metallic parts of the airplane form the counterpoise and as the trailing wire swings backward in a characteristic curve the major electrostatic field is projected downward ahead of the airplane at about 45 degrees.

This gives a directional effect directly ahead of the airplane. Signals behind the plane or to the side of the lateral axis are greatly weakened. Even when the plane banks on a turn, the signals ahead die down rapidly. Hence to transmit in any given direction the plane must be pointed in the direction of the receiving station and to find that direction by compass is not as easy as it seems.

Furthermore, an airplane might have to reverse its direction every time it desired to communicate with a given station, and on long flights this lack of control would be extremely inefficient, in view of the fuel thus lost and the time consumed.

In land radio for long distance transmission the towers supporting the aërial are built for a given directional effect. Where non-directional effect is desired an umbrella type of antenna is used. However, since the airplane must get the maximum efficiency in range from the least amount of aërial weight, an umbrella type antenna, even if practicable, would not be suited to the airplane.

When it is attempted to arrange a fixt antenna (as opposed to the trailing type, which is free to sway) on an airplane the limiting conditions of aërial capacity and structural areas impose very harsh conditions on the designer. Consider the capacity of a wire equal to the wing span of an airplane, seldom more than 30 feet, and with no means of suspending the aërial over a foot above the wing surface, and with comparatively little metal in the wing itself to give the desired field its maximum capacity. Wing spread is the longest overall dimension of the airplane in any case.

Fixt wire antennæ on airplanes have never attained results commensurate to their cost in installation and in reduced flying efficiency; for every wire that is thus exposed to the air means increased *head resistance* and a few wires can multiply head resistance to a very serious extent.

One design of fixt wire antenna which was used in the army combined the fixt type with the trailing type. (See Fig. 2.) Here the ends of the wire were not weighted and as they were constantly liable to become tangled in the controls such fine wire had to be used that their effective capacity, low enough with any practicable airplane antenna, was further reduced. Furthermore, the trailing wires were awkward in landing and in taking off, since they could not be reeled and the fixt wire system was an added menace, due to the fire hazard which they involved.

This "rig-up," however, was effective for *interplane communication* over short distances, not exceeding a mile, using a 200 watt fan-driven generator. Communication to the ground was easily establisht, but receiving from the ground was difficult. The directional effect was low ahead and strong to the rear of the airplane.

The results obtained in army aviation radio were generally satisfactory for their purpose, but in the broad field of commercial aviation, the *directional control* must be far more highly developed before the radio apparatus can be relied upon.

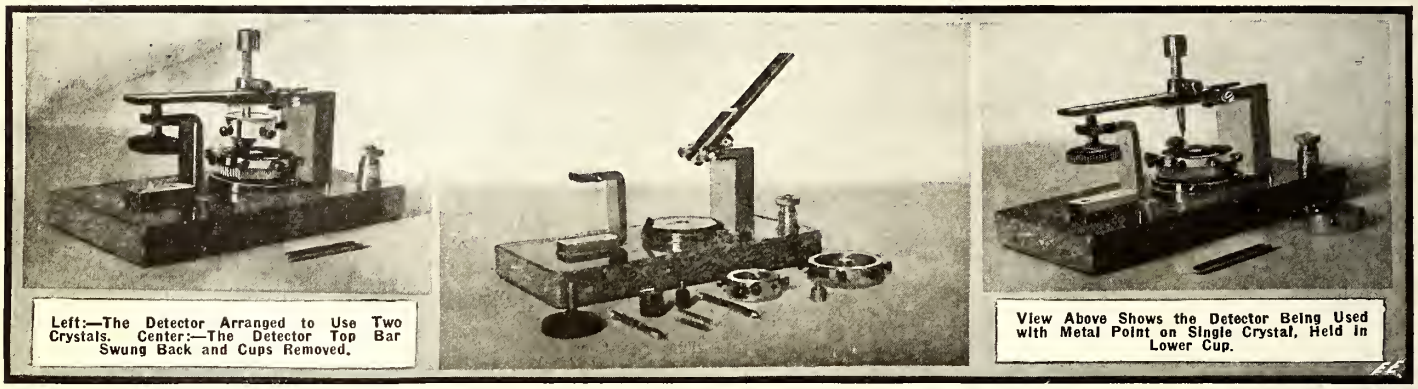
The same structural conditions which impose so many difficulties on directional control also affect selectivity of wave lengths. As is well known, a long wave length is more efficient for long distance transmission. To get long wave lengths a great deal of inductance and capacity are needed. The land radio operator little considers the

(*Continued on page* 588)

An Efficient Radio Crystal Detector

By ROBERT F. GOWEN, Radio Engineer

THE Multi-crystal Detector Mounting here illustrated is the result of an extended study by the author of many different forms of crystal detectors both commercial and home-made. It was built to provide a detector having the following characteristics: (1) Maximum sensitiveness; (2) Maximum robustness or power to hold its adjustment; (3) Maximum flexibility in its use.



Left:—The Detector Arranged to Use Two Crystals. Center:—The Detector Top Bar Swung Back and Cups Removed.

View Above Shows the Detector Being Used with Metal Point on Single Crystal, Held in Lower Cup.

Fig. 1 (at left) shows the mounting used to hold a pair of crystals or a crystal couple such as Zincite-Chalcopyrite or Zincite-Bornite. The electrodes are made eccentric to each other so that any point in the lower cup may be made to intersect with any point in the upper cup. The crystals are mounted in small brass thimbles by means of Wood's metal, Hugonium, or a similar soft solder and are held fast in the cups by means of the set screws.

By removing the upper cup a phosphor-bronze point is exposed which is used in connection with *Silicon*. When using *Carborundum*, the pin cup is unscrewed and the pin reversed to obtain a contact having a comparatively large area. When *Galena* is used, a pin shown in front of the instrument and having a very fine contact wire, takes the place of the pin shown in use. The lower cup is made large enough to hold several crystals at once so that in the case of one burning out, another may be immediately substituted by simply rotating the cup on its pedestal.

Rotating the cups also provides an easy method of determining the most sensitive crystal surfaces. It is only necessary to connect the detector in circuit with a test-buzzer and rotate the cups and thimbles until the head receivers show that the most sensitive crystal faces are in contact.

A good method of comparing the sensitiveness of different crystals is also a feature. This is accomplisht by inserting the several types of crystals in the large cup and bringing one after the other in contact with the pin while an observation for each is made with some type of receiver shunt. In this manner, the crystals may be separated into groups of varying sensitiveness for future use.

In order to change the cups it is simply necessary to throw the lever back against the spring as shown in Fig. 2 (at center). This cut shows the detector unassembled.

The large hole shown in the pedestal provides a bearing for the small shoulder shown in front of the large cup, into which it is screwed when in use; or if preferred, the large cup may be screwed on to the pin in the lever arm.

The small hole shown directly in front of the larger one is threaded to take an 8-32 machine screw which may be used to hold in place a small acid container for an electrolytic detector. In this case a third pin is used, to the end of which is soldered the fine Wollaston wire.

The adjustment screw on the front of the detector is provided with a very fine thread, thus assuring a very sensitive adjustment. The spiral spring shown in the unassembled view is slipt over the contact pin to allow of an easy adjustment while pushing the pin down in place, after which the pin is clamped in place by means of the set screw with its hard-rubber handle

The lever arm holding the pin moves in adjustable conical bearings in the fork mounted on the back piece and is held under tension by means of a flat, steel spring, the end of which may be seen directly over the bearings.

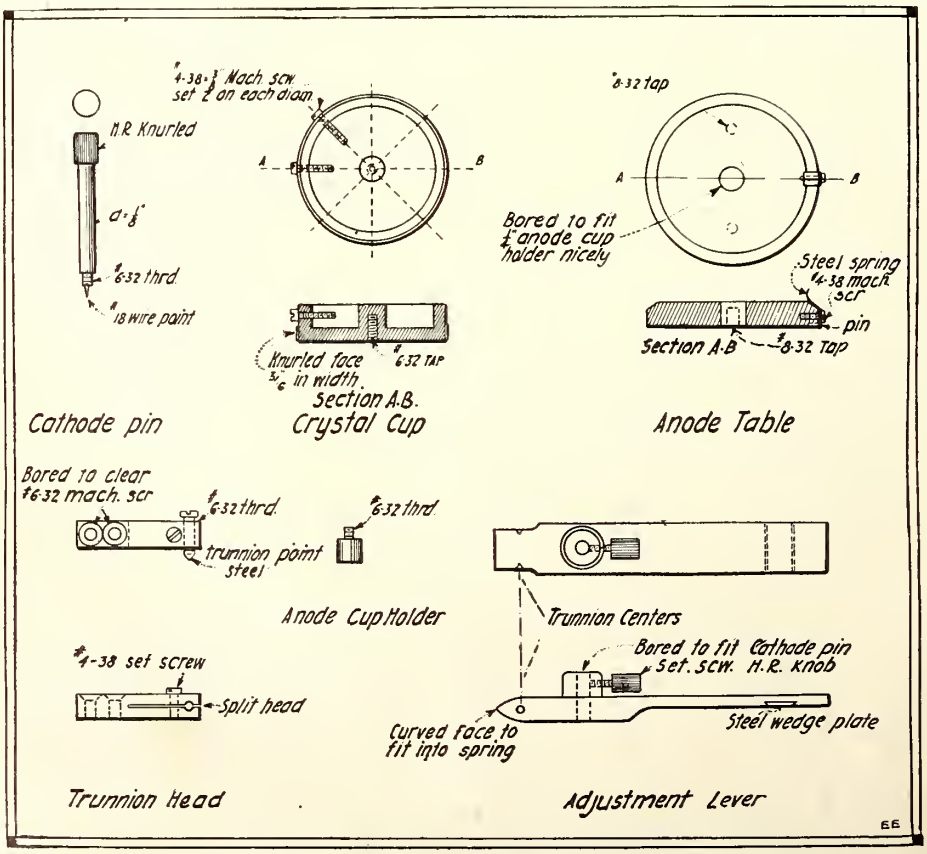
Experience has shown that for the experimenter the detector fulfills a long felt want in that the parts are entirely interchangeable and accessible. It may be used as a detector of any of the well known crystal types or as an electrolytic detector of the "whisker-point" type. By replacing the contact point with a small glass tube containing a fine platinum wire, a "Dip-point" electrolytic detector is provided.

To change from one detector to another it is simply necessary to throw back the lever arm and take out the cups. This action requires a very small time period to perform.

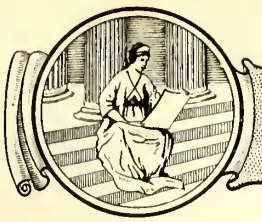
In order to adjust the detector the large cup is turned so that the crystal to be used is underneath the pin or upper crystal holder, whereupon the pin is pushed down against the spiral spring until contact is made, after which it is clamped in place by means of the set screw. The lower cup is then turned slightly until a good point of contact is obtained, whereupon the detector is brought into final adjustment by means of the sensitive adjusting screw at its front.

The author has found this type of detector to retain its adjustment for several weeks at a time and believes this is due to the use of a rigid marble base and the stiff, non-vibrating spring. For the base a special marble is used having a very high insulation value.

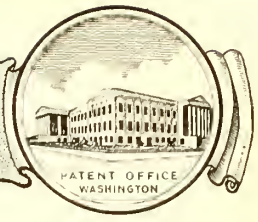
(*Cont. on page* 584)



Detail Drawings of Parts Used in Making Universal, Single or Multiple Crystal Detector.



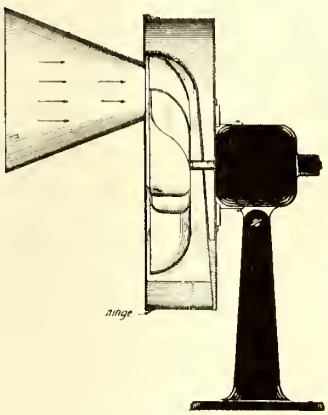
LATEST PATENTS



Electric Fly-Catcher.

(No. 1,311,281, issued to Maik Kurka.)

Of all the thousands of inven-

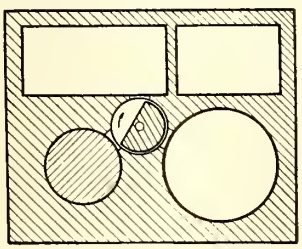


tions made monthly and yearly in this country, perhaps there is nothing at this time of the year which interests us more than a fly-catcher—and especially an electric fly-catcher, for by its very cognomen it must be good. This electric fan device for catching flies provides a specially designed blade which acts when rotating at a high speed to produce a suction thru the horn or tunnel, and the flies are whirled around inside the fan casing into the blind vault, where they conveniently die a most horrible death.

Electric Heat Storer.

(No. 1,311,464 issued to Oskar Sælid.)

An electric heat storing device, in which the heat may be accumulated

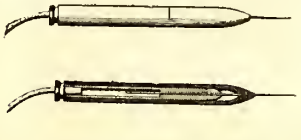


from an electric heating member or grid in a storing body placed in a chamber formed in a secure body of sealed "heat insulating" material. This is designed particularly to apply to electric heat-storing kitchen ranges. The heat generated electrically may be transferred thru special channels and a multiple heat valve to various heat-storing chambers. The heat may be conducted by metal members or by air-filled channels, as provided by the movement of the valve.

Electro-Surgical Needle.

(No. 1,311,494, issued to Ervin M. Camp.)

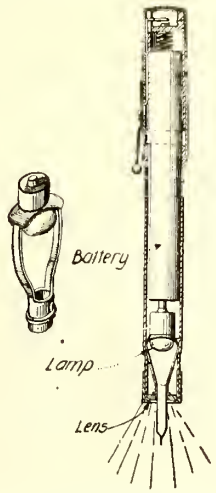
This electro-surgical needle is intended to provide a device of this kind, in which the electrically operated needle is provided with a grip chuck arranged to hold it positively in any desired position or adjustment. Further, the surgical needle is longitudinally adjustable in the gripping chuck, in such a manner as to project any distance.



Illuminated Pen or Pencil.

(No. 1,310,476, issued to Louis F. Hart.)

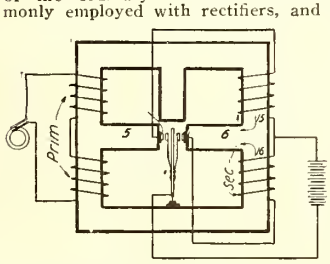
A novel writing instrument is here illustrated which may be in the form of a fountain pen or pencil. It is very cleverly designed, and incorporates a small incandescent electric lamp similar to a flash-light bulb, together with a small reflector lens and a tubular dry battery. There is also a clever cap switch for opening or closing the lamp circuit. The lamp bulb proper is mounted a short distance above the writing point in a special form of tripod as shown in the illustration; the light from the bulb flashing downward thru the lens having a hole thru its center to accommodate the pen or pencil point.



Vibrating Rectifier.

(No. 1,311,490, issued to Quincy A. Brackett.)

In the ordinary A.C. to D.C. vibrating rectifier, several of which have been on the market for an appreciable period of time, it is usual to provide two co-acting magnetic fluxes; one of these is uni-directional and the other alternating, the uni-directional flux being invariably supplied by a permanent magnet or from coils excited by auxiliary direct current. In the present design the inventor very cleverly arranges a special circuit for the rectifier, whereby he obtains both of these magnetic fluxes in a simple and yet effective manner, without the use of any windings except those of the ordinary transformer commonly employed with rectifiers, and

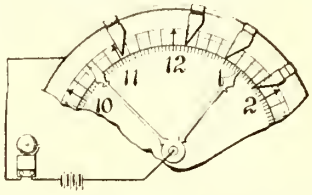


further without the use of a separate direct current exciting source. The alternate pulses of current in the two halves of the secondary winding will set up waves of magnetic flux, as indicated by the arrows 15 and 16, and these waves will consolidate to form a uni-directional magnetic flux thru the pole pieces 5 and 6, as becomes apparent. The vibrating reed will thus oscillate at synchronous speed and co-act with the uni-directional poles 5 and 6.

Electric Clock Alarm

(No. 1,311,424, issued to Benjamin H. M. Spargo.)

This electric clock alarm is devised with a number of adjustable contact

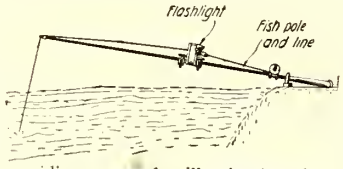


members, which may be arranged around the dial at any hour or fraction of an hour desired. One side of a bell and battery circuit is connected to the hands, while the other side connects to a metal member on which the contacts may be snapt into place. It is at once seen that the alarm may be arranged to ring as many times in the course of a day, as desired. This is often required in schools, offices, factories, etc.

Electric Fishing Signal.

(No. 1,309,365, issued to John E. Monighan.)

This invention comprises something which is of interest particularly to sportsmen and Nature-lovers during the warm months of the year. It comprises nothing else than the fisherman's rod, which supports a flashlight electric alarm for night fishing, so that the instant the fish bites on the hook and starts to unreel the line, the movement of the line thru a special trigger switch device on the flashlight holder, closes the circuit and the lamp flashes. Full details of the device are given in the patent and the action of the switch is simple and ingenious, permitting a line to be run out or wound up on the reel, without being interfered with in any way by the device, and yet

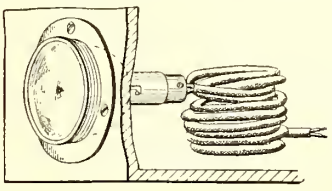


providing means for illuminating the flashlight whenever a fish bites.

Tonneau and Trouble Lamp.

(No. 1,311,295, issued to Jason C. Stearns.)

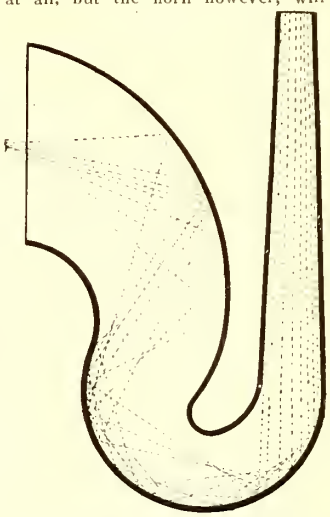
A useful and practical development in auto accessories, comprising an electric tonneau and trouble lamp, so constructed as to be capable of use in an efficient and convenient manner. The design of this lamp is carried out in such a manner that the lamp proper and its holder can be readily removed or replaced in its stationary receptacle on the auto dash or on the wall of a tonneau, etc. In order to do this, the inventor has provided a clever bayonet joint, by which the lamp is held rigidly in position when desired, or also easily and quickly removed, and when used as a portable trouble light, current is supplied to lamp thru a flexible duplex wire, which is normally coiled up in back of the lamp as the drawing shows.



Amplifying Horn.

(No. 1,311,478, issued to Russell A. Willson.)

A specially designed amplifying horn for use on phonographs and other similar instruments. The inventor claims that to give a clear-cut sound reproduction of a record, the horn must be so designed that each tone will be conveyed thru the horn so as to reach a certain focal point, after having travelled over approximately the "same distance" thru the horn, as have been travelled by other accompanying tones. In other words, the inventor states that the length of the sound waves or vibrations in the horn is the same. We do not agree with his theory at all, but the horn however, will

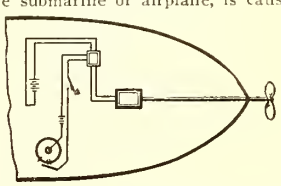


work in the usual manner in spite of it, if so we may express our idea of the matter. The inventor also mentions that the horn is designed rectangular in cross-section with diverging walls, while the outlet end of the amplifying portion is provided with parallel walls. Sound waves when conveyed thru a horn like this have a tendency to swirl or travel in a spiral direction giving inferior tone reproduction; the rectangular construction overcomes this by providing dead air spaces along the corners of the horn.

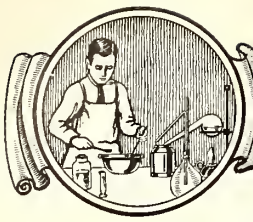
Submarine Signaling.

(No. 1,311,157, issued to Reginald A. Fessenden.)

This invention by Prof. Fessenden, relates to signaling by sound in a fluid media, such as water or air. It is also applicable to airplane signaling, and should prove particularly efficacious in sending out signals at night. The secret of this invention lies in the fact that either by means of automatic or key-operated electric switches, the electric circuit for driving the propeller on the submarine or airplane, is caused



to fluctuate a slight amount in its rotation. This need not be sufficient to cause the propeller to stop, but simply to cause a slight change in the humming note projected from the spinning propeller. The inventor states that he has tested this idea out under practical working conditions, and that slight variations in the notes are readily detected.



WITH the AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $5.00 PRIZE WINNER— EDWARD H. COX

I PRESENT herewith four flashlight photos of my "Experimental Laboratory." In the first photo may be seen my electrical test-board, all controlled from the small switch-board observed in the upper left-hand corner of photo. This switch-board is so wired that I can obtain 1½ volts; 24 volts A. C. or 120 volts A. C. thru a rheostat of my own design. Also 1½; 24 or 120 volts D. C. thru a rheostat, all from the plug shown on bottom of the fiber switch-board panel. There is also shown my submarine chaser model which is undergoing repairs at present. In front of this is a small brass steam engine constructed entirely without any lathe work. On the right-hand side of photo may be seen my electric furnace and high frequency set. In the upper centre is shown a safe operated entirely by electricity.

One photo shows my "Chemical Laboratory," while a third photo shows my wireless set and "Yours Truly." I have a wood-turning lathe and jig-saw which are not shown.—Edward H. Cox, 9 Pierce Avenue, Hamburg, N. Y.

HONORABLE MENTION— ARMAND DE PICHON $2.00 PRIZE PAID EACH "HONORABLE MENTION"

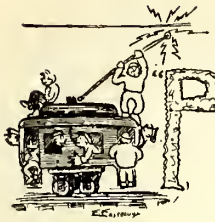
AFTER seeing numerous photos of Amateur "Labs" publisht, I at last decided to send some photos of my own. In my chemical "Lab." I have Florence and Erlemeyer flasks, a retort, pestle and mortar, test tubes, microscope and other apparata. My radio receiving set consists of a loose coupler, two detectors, two sets of receivers, a 43-plate variable condenser, switch, fixt condenser and a test buzzer. I also have quite a number of transmitting instruments, including a helix, transformer, key, spark coil, spark gap, D.P.D.T. switch for sending and receiving, and a fuse block switch. Some of my apparata is home-made, and I intend to put up my sending set sometime in the future, or as soon as the ban on transmitting sets is lifted by Uncle Sam.

I am now fixing up a switch-board in my electrical "Lab.", and I will send you some more photos of it when completed.

I find much useful and interesting information in your magazine, which I read constantly. Armand de Pichon, 1100 Morton Street, Alameda, Calif.

Science in Slang

By EMERSON EASTERLING



"POWER'S off," remarked a passenger as our trolley car came to a dead stop in absolute darkness.

"While we are so conditioned," I remarked, "would you mind spilling us a little anointment in the line of electro-propelled vehicles and the like, and so forth?"

"Yes," he replied. "I was just dying to slip you the oil, anyhow."

"Yes," spoke up a stranger from Missouri, "let us all in on it. I have a brother that knows a street car conductor in Vancouver, Washington. He works for the North Coast Power Company on the car that walks out to the Standifer Steel Ship Yards."

"Well," commenced Jazz, lighting up a cigar—and also the entire car. Over in one corner a man and a woman—but that is another story. "It all started way back in 1835——"

"Say, partner," reproved the rather aged man with the ditto woman in the corner, "you don't need to insinuate."

"As I was saying," continued Stokes, "a bird by the name of Tom Davenport invented——"

"A couch!" broke in a furniture dealer absent-mindedly.

"A Yankee by the name of Davenport invented an apparatus, contraption, or contrivance that was able to live up to the name of primeval surface jolter.

"About the same time a Scotch Highlander (or Lowlander), Bobbie Davidson —no relation to Harley as far as known— tried out a trolley in the 'auld' country.

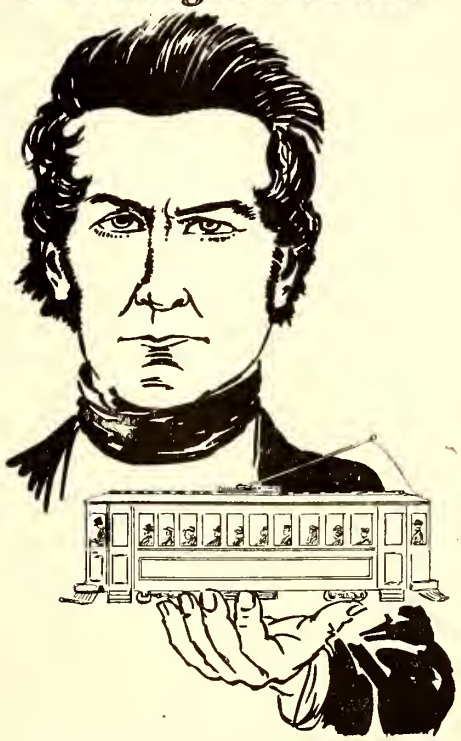
"In Washington, D. C., Prof. C. I. Page gave the public the sensation of seeing a real (almost) street car. That was way back in 1850.

"Moses G. Farmer stuck onto the public the first electro-bus with reduction gears from the motor—in spite of his name.

"But it was in Berlin that a couple of guys combined efforts and gave the grasping—or should I say yawning or reaching —world the pleasure of witnessing the first practical working model of life size—of the 'juice jerked' juggernaut. These ducks were Siemens and Halske. The same Siemens that is guilty for the early dynamos and motors that bear his John Hancock. No, not the one that met the pieman!

"From 1880 to 1883 Steve Fields and Tom Edison had a spat over patent rights, but finally they came to a settlement by forming a League of Notions; that is, they consolidated in the traffic jamming project. At the 'Chi' Railway Exhibition they showed off their first performance of their product and in a few years the people over the country were cautiously entering the moving houses and gripping to their seats and praying while the motorman did his best to 'keep things going' up in front.

Trucking the Traffic



A Yank by the Name of Tommie Davenport Invented an Apparatus, Contraption, or Contrivance, that was Able to Live Up to the Name of Primeval Surface Jolter.

"Kansas City was the first 'burg' to install an electric railway of any note. That was in '84. I don't know why that 'burg' should be first in the line any more than I know why it is one of the toughest towns in the States.

"The first line had the juice entering one rail and leaving the other. Then along come another model having the juice from double overhead trolleys, as in Kansas City. Another bird figgers out the third rail, and another the stunt of using the trolley and track, while still others carried the batteries aboard the municipal boxcar. Edison had a pretty fair example of the battery car.

"The original—and a lot of the subsequent—cars were put out with about the same horsepower as the present-day motorcycles. Think of it! They grew up to twenty horsepower, and then they *doubled* the power by furnishing both trucks with motors. The larger electrical interurban railways have ten times—and in some cases more than that—the power of the street cars."

"How do these strings of cars that snake thru the ways work?" asked a voice next to me. "They have only one engineer on the front car."

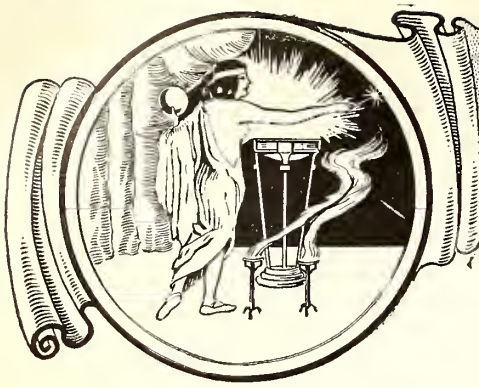
"They employ what we call the multiple unit system of control. The cars are connected together by connections at the ends of each car. The motorman at the head car in controlling his own car operates the other ones automatically. The—but if I would explain the workings of a single unit you would probably get me better.

"On the simple or single unit the juice is handled by resistance and varied connections at the control panel that the motorman operates. On starting the resistance and all the separate (the field coils are arranged so as to be connected series or multiple, or both—that is, some series and others multiple) field coils are in series with each other, the resistance and the armature. To increase the speed the resistance is first thrown out, then the field is changed from series to series and multiple and then to multiple; then the armature is connected multiple, making the motor shunt wound instead of series. If you should look out the window at this point you find yourself jazzing right along under ideal conditions.

"To get back home without turning the car around the motorman straddles thru the car to the other end and jams his crank down on the controller and when the conductor gets one trolley arm down and the other up—or the same one yanked around —the connections are now so arranged that the armature is in a different relation with the field; that is, the different judicial flow renders the magnetic jerk on the armature around to another field pole instead of the one that it did before—the result: 'reversed motion.' Also there is a separate control in each end that makes it possible for the street car to be backed up without going thru the above actions. This makes it nice in the 'traffic jams,' as it avoids the necessity of the passengers getting out and pushing said car back to let the auto truck, go-cart, bicycle, ice wagon, widow with pack-

(*Continued on page* 558)

Herr Werner von Siemens of Berlin Gave the World the Pleasure of Witnessing the First Practical Working Model of a Life-Size "Juice Jerked" Juggernaut. Von Siemens, as Will Be Seen, Is at the Helm. The Dope, Elektrische-Eisenbahn, Means Electrical Railway. And Pipe the 1880 Style of Clothes and Lids.



THE ORACLE

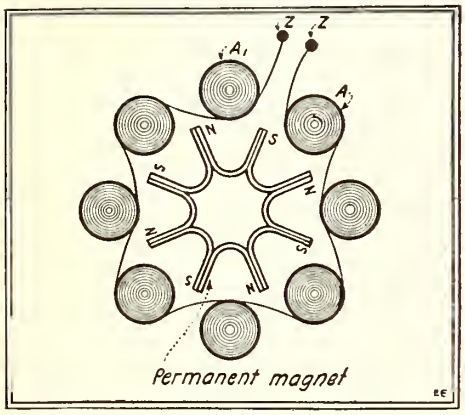
The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered. Your correct name and address must be signed.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

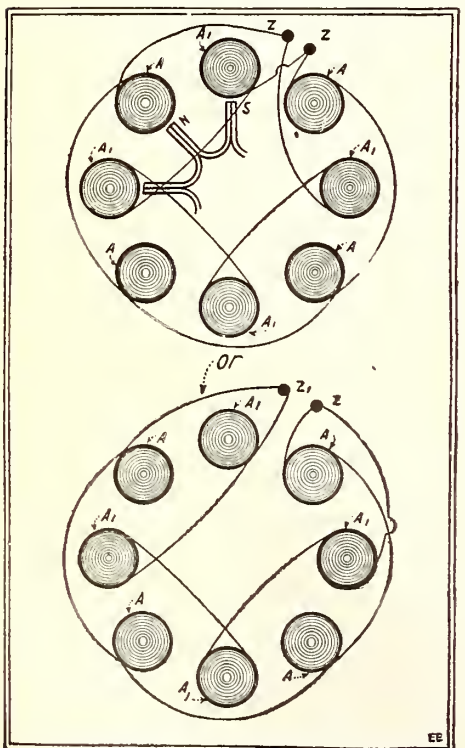
CHANGING THE FORD MAGNETO FROM A. C. TO D. C.

(1023) Rev. V. F. M., North Dakota, asks the "Oracle" several questions relative to converting the Ford auto magneto from A. C. to D. C.

A. 1. We have examined your diagram



Original Connections of Ford Magneto and Arrangement of Rotating Steel Magnets to Produce "Alternating" Current.



Two Proposed Re-connection Schemes for Ford Magnetos, in Order to Derive "Direct" Current. The Reason it Will Not Work as Anticipated Is Explained in the Accompanying Text.

and proposal for converting a Ford A. C. fly-wheel type magneto to a D. C. generator. We have looked over your diagrams carefully, but do not see that you will gain any such result by simply changing the connections and the coils, for the following reason. If you will take, for example, one of your diagrams where you have changed the windings so as to have two series of four poles each, and select a given pole, let us say, A, and note that the revolving steel magnets having alternate north and south poles, of course you will see that this coil will, for example, first be acted upon by a moving *north* pole—and then successively by a moving *south* pole, then by a *north* pole, etc., etc. This will mean, of course, that an *alternating current* will be set up in that particular coil, and in all the other coils so situated and acted upon in that circuit.

Your suggestion prompts the following discussion: Your idea would seem to be the same as trying to get direct current from a revolving field type of alternating current generator, without using a commutator. And here the same reasoning as just set forth comes into force, i. e., you must not forget that in any such case as this the *north* and *south* field magnet poles act alternately on each winding coil, pole or unit, many times per minute. Therefore you will get, as we always do get from a revolving field type of alternator, an *alternating current.* The simplest solution of the whole problem would appear to be to either rig up a commutator on the machine or else to use a D. C. dynamo, and this can be purchased for about $10.00. The Ford magneto, which is an A. C. type of course, owing to its fundamental design, is very rugged, simple and efficient, all things considered, as it only operates the lamps, and in some cases an electric siren, the A. C. current does the work in a thoroly efficient manner. Where a self-starter is fitted to a Ford, which is very exceptional in the Editor's observations, a storage battery is used for operating the starting motor, and this *same* motor is utilized as a charging dynamo by a simple relay arrangement, which changes the circuits for either requirements. The Ford A. C. magneto operates all right as a generator, but it would certainly work very poorly as a motor under any consideration.

TRAIN-DISPATCHING SELECTOR.

(1024) H. H. Gowan, Peterboro, Ont., Canada, writes:—

Q. 1. What book or manual is there available on the subject of train-dispatching selectors?

A. 1. Regarding the details of the "Selector" used on the Western Electric Railroad telephone dispatching system, would say that, so far as the Editor knows, there is no special book on the subject, but the best thing to do, as he has found, is to obtain copies of some of their patents which explain the matter fully. One of these patents which proves very interesting is U. S. Patent No. 1,244,544, which we can supply for 10c.

SPINTHARISCOPE.

(1025) Paul S. Howard, Okmulgee, Okla., asks:—

Q. 1. About construction of a home-made spinthariscope?

A. 1. The microscope by itself cannot be used as a radium spinthariscope. It is necessary to have radium or some radio-active material at one end of your magnifying tube in order to have a spinthariscope. The radio-active substance must be mixed with zinc sulfid or arranged just above a disc covered with the zinc sulfid. The alpha particles shooting off from the radium and colliding with the zinc sulfid is what gives the effect of the "shooting stars." This radio-active material may be secured from radium supply companies.

Why Electrical Workers Are Needed.

Consider for a moment what part electricity plays in every-day life, in the comfort, convenience, pleasure and even health of the whole civilized world.

Think of having to ride in horse cars again—

of writing a letter every time you now phone—

of waiting days for what the telegraph does in a few minutes—

of no automobiles or moving picture shows—

Electricity takes millions to and from work. Without it the automobile and airplane would be impossible—the telephone and telegraph would be useless. All the civilized world relies on it for light, heat, transportation and communication. In a thousand ways electricity is used in factories, offices and in the homes.

Electricity is almost as essential as the air we breathe. Business would be almost at a standstill if deprived of its energy.

To say that electricity is still in its infancy is no exaggeration. Every day brings into practical use some new method of controlling it, some new device or appliance for using it. In industrial work there are still scores of operations where electricity will be utilized sooner or later. The day is coming when the railroads will entirely replace steam with electricity. Doctors, dentists and scientists are only beginning to realize the possibilities af electrical energy.

These facts merely touch the high spots, yet they prove beyond a doubt that electricity plays a vital part in business, in our individual lives, and that there is unlimited scope for those who make electricity their life work.

The electrical worker provides other men light to work by, the telephone and telegraph to convey their orders, the power to run their machines and transport their goods. He supplies power in the homes to operate washing machines, vacuum cleaners; for ironing, heating and ventilating. In short, it is the electrical worker who makes it possible for the world to live more comfortably, to enjoy more pleasures and to do a bigger, more profitable business.

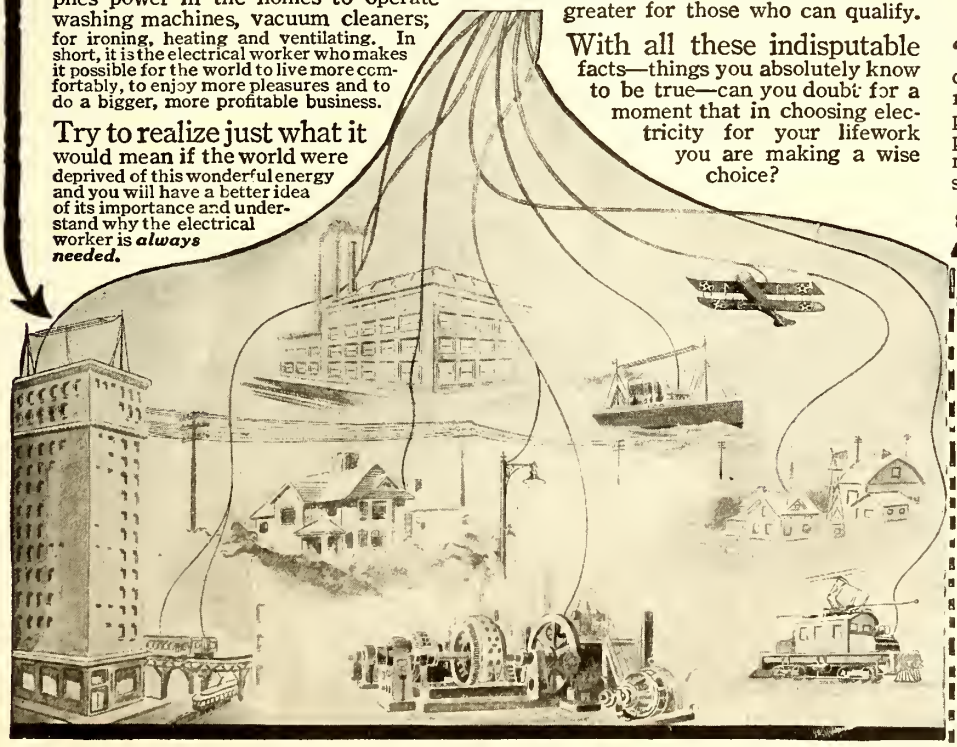
Try to realize just what it would mean if the world were deprived of this wonderful energy and you will have a better idea of its importance and understand why the electrical worker is *always needed.*

What Electricity Offers You

Once you have mastered the A-B-C of electricity you are confronted with unlimited opportunities for advancement. You can specialize in extending and perfecting the wonders already accomplished in the field. You may take up those branches of electrical and mechanical work which cover the design and manufacture of electrical apparatus or start in to qualify for a well-paid position in the designing, construction, operating or consulting branches of the electrical engineering profession, and to fit yourself eventually for a position as Distribution, Operating, Testing, Erecting or Designing Engineer.

In the automobile, airplane, telephone and telegraph lines there is also great scope for the trained electrician. Many wonders of electricity have yet to be unfolded—its uses multiplied—and opportunities still greater for those who can qualify.

With all these indisputable facts—things you absolutely know to be true—can you doubt for a moment that in choosing electricity for your lifework you are making a wise choice?



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..Telephone Engineer	..Shop Superintendent
..Draftsman and Designer	..Steam Engineer
..Automobile Engineer	..Stenographer

Name.....

Address.....

.....

"Piped Cold" — Prof. Bell Has It

(*Continued from page* 517)

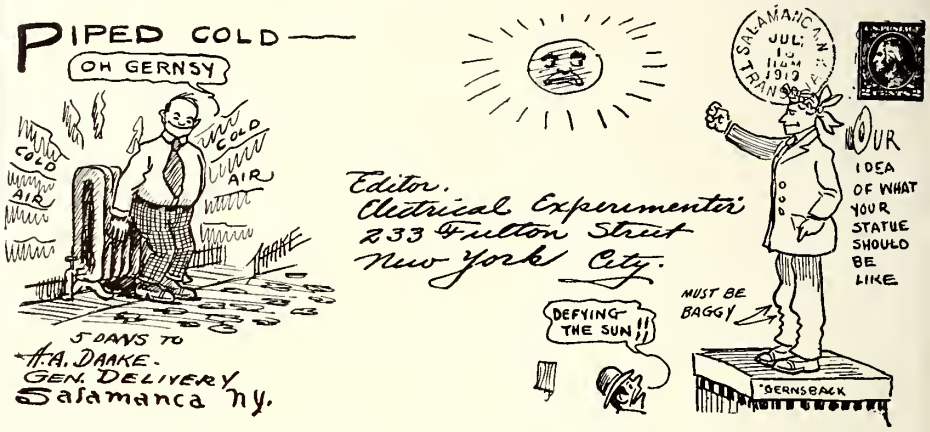
our radiators and pipes. But we prefer not only to let our babies and our feeble old folk die unnecessarily every summer, but we actually lose untold millions of dollars thru non-production when the "dog-days" are upon us. No one can work at his best when the mercury climbs to dizzy heights. Production, whether mental or physical, slows down anywhere between forty and eighty per cent. Statistics prove it. Factories as well as offices slow down and just barely creep along. Think of this enormous, incalculable loss alone, not to mention all the physical suffering due to the heat.

Ah, yes, we *do* have our brave fans—which, however, do not cool at all, but only remind us how hot our bodies are the minute we are not in the immediate vicinity of one of these spinning monuments to our stupidity.

For our dear fans only stir up the hot air *and* the dust. Our skin, wet or moist from perspiration, meets this stirred up air and due to a well-known physical phenomenon, *surface evaporation*, we experience a *sense of coolness*, but the air itself is *not* cooled. It is true that surface evaporation produces cold, but in order to have it, it is necessary to let the fans blow upon us, or nearly so, and everyone knows this is far from healthy, frequently producing severe colds. Besides, as soon as we leave the fan our suffering from the heat is all the more acute.

Where is the practical genius who will "study up" on refrigeration and sell us a cheap refrigerating machine which we can connect to our already existing steam or hot water radiators? For the same money which we now spend on fans we ought to be able to buy the machine. And for the money it costs to run the fans we can run the refrigerator, too.

Hundreds of refrigerators have been invented, but the simplest and best no doubt for our purpose is the *cold-air process*. It is based on the principle that the compression of air generates heat and in its subsequent expansion absorbs heat. The air is first comprest, is then past thru a cooler under pressure, after which it is expanded in a cylinder. No chemicals are used with this system and it possesses the very distinct advantage that extremely low temperatures are readily obtainable.



What H. A. Daake, of Salamanca, N. Y., Thought of Mr. Gernsback's Editorial "Piped Cold."

My Inventions

By Nikola Tesla

(*Continued from page* 508)

receiver. The higher the terminal and the greater the space encompast by the wires, the more pronounced is the effect, but it must be understood that it is purely local and has little to do with the real trouble. In 1900, while perfecting my wireless system, one form of apparatus comprised four antennae. These were carefully calibrated to the same frequency and connected in multiple with the object of magnifying the action, in receiving from any direction. When I desired to ascertain the origin of the transmitted impulses, each diagonally situated pair was put in series with a primary coil energizing the detector circuit. In the former case the sound was loud in the telephone; in the latter it ceased, as expected, the two antennae neutralizing each other, but the true statics manifested themselves in both instances and I had to devise special preventives embodying different principles.

The Remedy for Static.

By employing receivers connected to two points of the ground, as suggested by me long ago, this trouble caused by the charged air, which is very serious in the structures as now built, is nullified and besides, the liability of all kinds of interference is reduced to about one-half, because of the directional character of the circuit. This was perfectly self-evident, but came as a revelation to some simple-minded wireless folks whose experience was confined to forms of apparatus that could have been improved with an axe, and they have been disposing of the bear's skin before killing him. If it were true that strays performed such antics, it would be easy to get rid of them by receiving without aerials. But, as a matter of fact, a wire buried in the ground which, conforming to this view, should be absolutely immune, is more susceptible to certain extraneous impulses than one placed vertically in the air. To state it fairly, a slight progress has been made, but not by virtue of any particular

(*Continued on page* 552)

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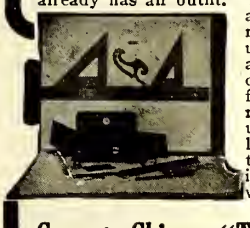

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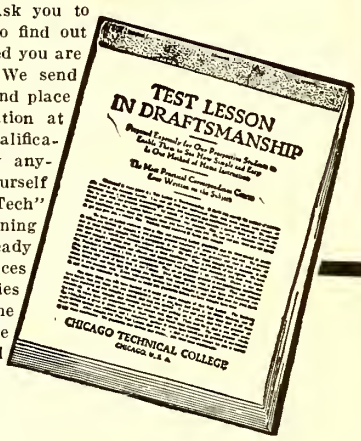

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My Inventions

By Nikola Tesla

(*Continued from page* 550)

method or device. It was achieved simply by discarding the enormous structures, which are bad enough for transmission but wholly unsuitable for reception, and adopting a more appropriate type of receiver. As I pointed out in a previous article, to dispose of this difficulty for good, a radical change must be made in the system, and the sooner this is done the better.

Radio Government Control Not Wanted.

It would be calamitous, indeed, if at this time when the art is in its infancy and the vast majority, not excepting even experts, have no conception of its ultimate possibilities, a measure would be rushed through the legislature making it a government monopoly. This was proposed a few weeks ago by Secretary Daniels, and no doubt that distinguished official has made his appeal to the Senate and House of Representatives with sincere conviction. But universal evidence unmistakably shows that the best results are always obtained in healthful commercial competition. There are, however, exceptional reasons why wireless should be given the fullest freedom of development. In the first place it offers prospects immeasurably greater and more vital to betterment of human life than any other invention or discovery in the history of man. Then again, it must be understood that this wonderful art has been, in its entirety, evolved here and can be called "American" with more right and propriety than the telephone, the incandescent lamp or the aeroplane. Enterprising press agents and stock jobbers have been so successful in spreading misinformation that even so excellent a periodical as the *Scientific American* accords the chief credit to a foreign country. The Germans, of course, gave us the Hertz-waves and the Russian, English, French and Italian experts were quick in using them for signaling purposes. It was an obvious application of the new agent and accomplished with the old classical and unimproved induction coil—scarcely anything more than another kind of heliography. The radius of transmission was very limited, the results attained of little value, and the Hertz oscillations, as a means for conveying intelligence, could have been advantageously replaced by sound-waves, which I advocated in 1891. Moreover, all of these attempts were made three years after the basic principles of the wireless system, which is universally employed to-day, and its potent instrumentalities had been clearly described and developed in America. No trace of those Hertzian appliances and methods remains today. We have proceeded in the very opposite direction and what has been done is the product of the brains and efforts of citizens of this country. The fundamental patents have expired and the opportunities are open to all. The chief argument of the Secretary is based on interference. According to his statement, reported in the New York *Herald* of July 29th, signals from a powerful station can be intercepted in every village of the world. In view of this fact, which was demonstrated in my experiments of 1900, it would be of little use to impose restrictions in the United States.

America First.

As throwing light on this point, I may mention that only recently an odd looking gentleman called on me with the object of enlisting my services in the construction of world transmitters in some distant land. "We have no money," he said, "but carloads of solid gold and we will give you a liberal amount." I told him that I wanted to see first what will be done with my inventions in America, and this ended the interview. But I am satisfied that some dark forces are at work, and as time goes on the maintenance of continuous communication will be rendered more difficult. The only remedy is a system immune against interruption. It has been perfected, it exists, and all that is necessary is to put it in operation.

The terrible conflict is still uppermost in the minds and perhaps the greatest importance will be attached to the Magnifying Transmitter as a machine for attack and defense, more particularly in connection with *Telautomatics*. This invention is a logical outcome of observations begun in my boyhood and continued thruout my life. When the first results were publisht the *Electrical Review* stated editorially that it would become one of the "most potent factors in the advance and civilization of mankind." The time is not distant when this prediction will be fulfilled. In 1898 and 1900 it was offered to the Government and might have been adopted were I one of those who would go to Alexander's shepherd when they want a favor from Alexander. At that time I really thought that it would abolish war, because of its unlimited destructiveness and exclusion of the personal element of combat. But while I have not lost faith in its potentialities, my views have changed since.

The Road to Permanent Peace.

War can not be avoided until the physical cause for its recurrence is removed and this, in the last analysis, is the vast extent of the planet on which we live. Only thru annihilation of distance in every respect as, the conveyance of intelligence, transport of passengers and supplies and transmission of energy will conditions be brought about some day, insuring permanency of friendly relations. What we now want most is closer contact and better understanding between individuals and communities all over the earth, and the elimination of that fanatic devotion to exalted ideals of national egoism and pride which is always prone to plunge the world into primeval barbarism and strife. No league or parliamentary act of any kind will ever prevent such a calamity. These are only new devices for putting the weak at the mercy of the strong. I have exprest myself in this regard fourteen years ago, when a combination of a few leading governments—a sort of Holy Alliance—was advocated by the late Andrew Carnegie, who may be fairly considered as the father of this idea, having given to it more publicity and impetus than anybody else prior to the efforts of the President. While it can not be denied that such a pact might be of material advantage to some less fortunate peoples, it can not attain the chief object sought. Peace can only come as a natural consequence of universal enlightenment and merging of races, and we are still far from this blissful realization. As I view the world of today, in the light of the gigantic struggle we have witnest, I am filled with conviction that the interests of humanity would be best served if the United States remained true to its traditions and kept out of "entangling alliances." Situated as it is, geographically, remote from the theaters of impending conflicts, without incentive to territorial aggrandizement, with inexhaustible resources and immense population thoroly imbued with the spirit of liberty and right, this country is placed in a unique and privileged position. It is thus able to exert, independently, its colossal strength and moral force to the benefit of all, more judiciously and effectively, than as member of a league.

(*Continued on page* 554)

My Inventions

By Nikola Tesla

(*Continued from page* 552)

The Mechanistic Theory of Life.

In one of these biographical sketches, published in the ELECTRICAL EXPERIMENTER, I have dwelt on the circumstances of my early life and told of an affliction which compelled me to unremitting exercise of imagination and self-observation. This mental activity, at first involuntary under the pressure of illness and suffering, gradually became second nature and led me finally to recognize that I was but an automaton devoid of free will in thought and action and merely responsive to the forces of the environment. Our bodies are of such complexity of structure, the motions we perform are so numerous and involved, and the external impressions on our sense organs to such a degree delicate and elusive that it is hard for the average person to grasp this fact. And yet nothing is more convincing to the trained investigator than the mechanistic theory of life which had been, in a measure, understood and propounded by Descartes three hundred years ago. But in his time many important functions of our organism were unknown and, especially with respect to the nature of light and the construction and operation of the eye, philosophers were in the dark. In recent years the progress of scientific research in these fields has been such as to leave no room for a doubt in regard to this view on which many works have been published. One of its ablest and most eloquent exponents is, perhaps, Felix Le Dantec, formerly assistant of Pasteur. Prof. Jacques Loeb has performed remarkable experiments in heliotropism, clearly establishing the controlling power of light in lower forms of organisms, and his latest book, "Forced Movements," is revelatory. But while men of science accept this theory simply as any other that is recognized, to me it is a truth which I hourly demonstrate by every act and thought of mine. The consciousness of the external impression prompting me to any kind of exertion, physical or mental, is ever present in my mind. Only on very rare occasions, when I was in a state of exceptional concentration, have I found difficulty in locating the original impulses.

Lack of Observation a Form of Ignorance.

The by far greater number of human beings are never aware of what is passing around and within them, and millions fall victims of disease and die prematurely just on this account. The commonest, every-day occurrences appear to them mysterious and inexplicable. One may feel a sudden wave of sadness and rake his brain for an explanation when he might have noticed that it was caused by a cloud cutting off the rays of the sun. He may see the image of a friend dear to him under conditions which he construes as very peculiar, when only shortly before he has passed him in the street or seen his photograph somewhere. When he loses a collar button he fusses and swears for an hour, being unable to visualize his previous actions and locate the object directly. Deficient observation is merely a form of ignorance and responsible for the many morbid notions and foolish ideas prevailing. There is not more than one out of every ten persons who does not believe in telepathy and other psychic manifestations, spiritualism and communion with the dead, and who would refuse to listen to willing or unwilling deceivers. Just to illustrate how deeply rooted this tendency has become even among the clear-headed American population, I may mention a comical incident.

Psychic Phenomena in the Manufacture of Flivvers.

Shortly before the war, when the exhibition of my turbines in this city elicited widespread comment in the technical papers, I anticipated that there would be a scramble among manufacturers to get hold of the invention, and I had particular designs on that man from Detroit who has an uncanny faculty for accumulating millions. So confident was I that he would turn up some day, that I declared this as certain to my secretary and assistants. Sure enough, one fine morning a body of engineers from the Ford Motor Company presented themselves with the request of discussing with me an important project. "Didn't I tell you?" I remarked triumphantly to my employees, and one of them said, "You are amazing, Mr. Tesla; everything comes out exactly as you predict." As soon as these hard-headed men were seated I, of course, immediately began to extol the wonderful features of my turbine, when the spokesmen interrupted me and said, "We know all about this, but we are on a special errand. We have formed a psychological society for the investigation of psychic phenomena and we want you to join us in this undertaking." I suppose those engineers never knew how near they came to being fired out of my office.

Confuting Spiritism.

Ever since I was told by some of the greatest men of the time, leaders in science whose names are immortal, that I am possesst of an unusual mind, I bent all my thinking faculties on the solution of great problems regardless of sacrifice. For many years I endeavored to solve the enigma of death, and watched eagerly for every kind of spiritual indication. But only once in the course of my existence have I had an experience which momentarily impressed me as supernatural. It was at the time of my mother's death. I had become completely exhausted by pain and long vigilance, and one night was carried to a building about two blocks from our home. As I lay helpless there, I thought that if my mother died while I was away from her bedside she would surely give me a sign. Two or three months before I was in London in company with my late friend, Sir William Crookes, when spiritualism was discussed, and I was under the full sway of these thoughts. I might not have paid attention to other men, but was susceptible to his arguments as it was his epochal work on radiant matter, which I had read as a student, that made me embrace the electrical career. I reflected that the conditions for a look into the beyond were most favorable, for my mother was a woman of genius and particularly excelling in the powers of intuition. During the whole night every fiber in my brain was strained in expectancy, but nothing happened until early in the morning, when I fell in a sleep, or perhaps a swoon, and saw a cloud carrying angelic figures of marvelous beauty, one of whom gazed upon me lovingly and gradually assumed the features of my mother. The appearance slowly floated across the room and vanished, and I was awakened by an indescribably sweet song of many voices. In that instant a certitude, which no words can express, came upon me that my mother had just died. And that was true. I was unable to understand the tremendous weight of the painful knowledge I received in advance, and wrote a letter to Sir William Crookes while still under the domination of these impressions and in poor bodily health. When I recovered I sought for a long time the ex-

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My Inventions

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ternal cause of this strange manifestation and, to my great relief, I succeeded after many months of fruitless effort. I had seen the painting of a celebrated artist, representing allegorically one of the seasons in the form of a cloud with a group of angels which seemed to actually float in the air, and this had struck me forcefully. It was exactly the same that appeared in my dream, with the exception of my mother's likeness. The music came from the choir in the church nearby at the early mass of Easter morning, explaining everything satisfactorily in conformity with scientific facts.

This occurred long ago, and I have never had the faintest reason since to change my views on psychical and spiritual phenomena, for which there is absolutely no foundation. The belief in these is the natural outgrowth of intellectual development. Religious dogmas are no longer accepted in their orthodox meaning, but every individual clings to faith in a supreme power of some kind. We all must have an ideal to govern our conduct and insure contentment, but it is immaterial whether it be one of creed, art, science or anything else, so long as it fulfills the function of a dematerializing force. It is essential to the peaceful existence of humanity as a whole that one common conception should prevail.

Tesla's Astounding Discovery.

While I have failed to obtain any evidence in support of the contentions of psychologists and spiritualists, I have proved to my complete satisfaction the automatism of life, not only through continuous observations of individual actions, but even more conclusively through certain generalizations. These amount to a discovery which I consider of the greatest moment to human society, and on which I shall briefly dwell. I got the first inkling of this astounding truth when I was still a very young man, but for many years I interpreted what I noted simply as coincidences. Namely, whenever either myself or a person to whom I was attached, or a cause to which I was devoted, was hurt by others in a particular way, which might be best popularly characterized as the most unfair imaginable, I experienced a singular and undefinable pain which, for want of a better term, I have qualified as "cosmic," and shortly thereafter, and invariably, those who had inflicted it came to grief. After many such cases I confided this to a number of friends, who had the opportunity to convince themselves of the truth of the theory which I have gradually formulated and which may be stated in the following few words:

Our bodies are of similar construction and exposed to the same external influences. This results in likeness of response and concordance of the general activities on which all our social and other rules and laws are based. We are automata entirely controlled by the forces of the medium, being tossed about like corks on the surface of the water, but mistaking the resultant of the impulses from the outside for free will. The movements and other actions we perform are always life preservative and tho seemingly quite independent from one another, we are connected by invisible links. So long as the organism is in perfect order it responds accurately to the agents that prompt it, but the moment that there is some derangement in any individual, his self-preservative power is impaired. Everybody understands, of course, that if one becomes deaf, has his eyesight weakened, or his limbs injured, the chances for his continued existence are lessened. But

(*Continued on page* 600)

Which Job Do You Want?

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Science in Slang

By Emerson Easterling

(*Continued from page* 547)

ages, baby buggy, and other objects ahead untangle and get on their way. And it always looks more graceful to see the cars running under their own power, too."

"How about the lights and heat in the cars?" spoke up a stranger. Then, after apparent thought, "Oh, of course it comes in like the power."

"Of course," replied Jazz.

Just then the power came on. The lights flashed up again. We were lighted as well

Here We Have Tommy Edison Running His First Model of the Electrical Railway Somewhere Over the Jersey Flats, And Believe Us, It Worked.

as enlightened. (How do you get that way.)

Somehow I couldn't help looking around at the couple in the corner. They were gone. But some rice was left in the seat. I don't know whether they will have rice or eggs for breakfast, tho.

"Does it make much difference whether they use direct or alternating current for the cars?" I asked of Stokes.

"Not much," he answered back as he spit out of the window of the car, now in motion.

EDISON VS. SPRAGUE ON ELECTRIC RAILWAYS

To the Editor of the New York Sun.

SIR: I have noticed in your paper of August 27, 1919, a communication from Frank J. Sprague in which he takes me to task for claiming in a recently published article the invention of the trolley car.

Mr. Sprague's principal contribution to the trolley car was the mechanical suspension of the electric motor to the truck. The motor itself was the modern reversible, low resistance, high efficiency, dynamo-motor devised and developed by me in working out the incandescent electric light system. This was already invented and at hand for Mr. Sprague to adopt to the conditions of a railway car truck. Neither he nor Siemens nor any one else could have succeeded in making a trolley system commercially practicable without this development.

A trolley car does not constitute a trolley system. A central current generation and distributing station and a complete system of conductors are absolute necessities. I had already spent years in their development for the incandescent electric light system and they were available to Mr. Sprague.

Mr. Sprague states also that he had great financial difficulties in introducing the trolley system into Richmond and carried it out largely by his personal credit. Perhaps he has forgotten that when his com-

pany was without funds and the Richmond project was in a serious situation, due to too much mathematics on the part of Mr. Sprague, I came forward and trusted his company for over $100,000 worth of apparatus and the aid of my men to pull the scheme thru.

What Mr. Sprague can really claim is that by his persistence and electrical knowledge he was the first one to start the trolley car system commercially. This is what I have always thought and publicly stated.

THOMAS A. EDISON.

Orange, N. J., September 3.

Treasure Ships Located Electrically

(*Continued from page* 512)

simple matter to locate the wreck. All the commander of his submarine will have to do is to cruise back and forth near the spot where the sunken vessel is supposed to lie. Sooner or later the faithful induction balance will find the wreck.

In our illustration it will be seen that the balances can be raised or lowered by means of winches on board the submarine. This is necessary because the submarine floats at a certain level. The depth of the ocean naturally varies more or less; if a deeper strata is encountered, the induction balances must be lowered further than in cruising in shallow water. Not only will the induction balance give us the exact spot where the ship is located, but it will also give us the exact location if the ship should be entirely covered with sand or silt.

The cost of an outfit of this kind is negligible, as such an under-water Hughes balance can be constructed for less than $100.

MEASUREMENTS OF WAVE-LENGTHS IN THE SPECTRUM OF NEON.

The lines in the neon spectrum are very sharp, a quality which recommends this gas as a standard source wherever the lines have sufficient strength. The ultra-violet group between 3369A and 3520A may be used for standards, and there are a few good infra-red lines, but the strength and distribution of the lines in the region 5852A to 7438A make the neon spectrum particularly useful as a comparison in this region, says the *Bureau of Standards* Bulletin.

The wave-lengths of fifty-five lines in the neon spectrum have been measured by means of the interferometer. These lines lie in the region of 3369A to 8495A. The strong lines in the visible region of the spectrum have been observed with great accuracy, the probable error being one part in several millions, or less than one-tenth the width of the line. These strong lines were observed by means of three different pairs of interferometer plates, which were each used on several interferometers. The ultra-violet lines and all the strong lines in the visible were compared directly with the fundamental standards 6438A. Some of the deep red and infra-red lines were compared with well-determined lines in the visible neon spectrum.

One hundred and eighty-nine faint lines in the visible and infra-red neon spectrum have been measured by means of a concave grating. The probable error of these grating measurements is one or two hundredths angstrom. The region covered by the grating observations extends from 5343A to 8783A.

The constant differences discovered by Watson are found to hold with remarkable exactness in the case of lines which are strong enough to be measured with the highest accuracy. In fact, the differences are exactly constant within the limits set by the accuracy of the wave-lengths.

(*Continued on page* 560)

(*Continued from page* 559)

The Submarine's Underwater Radio

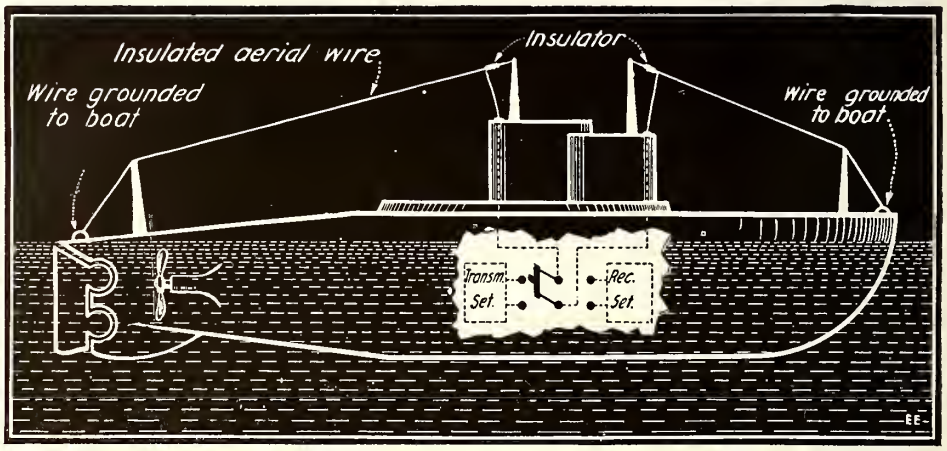
(*Continued from page* 539)

"Messrs. Willoughby and Lowell, of the Bureau of Standards, working for the Navy Department, have completed a series of experiments in transmitting and receiving radio signals on board submarines. Their results from using a single turn "loop" are very promising and incorporate the most complete data ever obtained in receiving and sending radio signals on board submarines."

Signals Received 6,000 Miles.

We are glad to have the opportunity of presenting herewith official report on the work in "Submarine Radio" conducted by Messrs. Willoughby and Lowell, of the Bureau of Standards, in coöperation with the Navy Department, at the submarine base at New London, Conn. In the tabulated results below we find one of the most remarkable wireless tests ever conducted—a submarine under water receiving signals from Nauen, Germany, *a distance of* 6,000 *miles*. The submarine was submerged eight feet during this particular test. We are indebted for this information to Dr.

(*Continued on page* 584)



The New Submarine Loop Antenna as Installed by the Radio Engineers Who Made the Tests Here Cited. The Receiving Record—6000 Miles.

"RECEPTION" RESULTS, ON BOARD SUBMARINE

Date 1918	Wave length in meters	Distance in miles	Power	Depths at which readable signals could be heard, measured from top of loop to surface of water
June 10	6000	200	100 k. w. undamped (Arlington)	16 ft.
June 11	9600	100	150 k. w. undamped (N. Brunswick)	21 ft.
June 11	9600	100	150 k. w. undamped (Tuckerton)	21 ft.
June 21	10000	3000	250 k. w. undamped (San Diego)	8 ft.
June 21	13000	6000	? undamped (Nauen, Germany)	8 ft.
June 21	2500	200	Arlington's Spar's	8 ft.

"TRANSMISSION" RESULTS, ON BOARD SUBMARINE

Date	Wave Length in Meters	Actual Distance in Miles	Estimated Maximum Distance in Miles	Current in Amperes	Remarks
1918 Sept. 12	540	50	150	12	Submarines running full speed on surface in heavy sea.
Sept. 12	600	50	150	11	Submarines running full speed on surface in heavy sea.
Sept. 12	756	50	100	10	Submarines running full speed on surface in heavy sea.
Sept. 12	952	50	80	8	Submarines running full speed on surface in heavy sea.
Sept. 16	540	97	150	12	Submarine tied up at dock.

			Current in Amperes		
			Surface	Submerged	
Sept. 9	952	12	12	6	Submarine submerged running full speed with top of loop near surface.
Sept. 16	952	9	12	6	Submarine submerged and balanced so that top of loop was submerged a few inches.
Sept. 16	952	3	12	6	Submarine submerged and balanced with top of loop submerged 9 feet.

18 cents a package

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes; or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.

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YOU'LL prefer Camel Cigarettes expert blend of choice Turkish and choice Domestic tobaccos to either kind smoked straight. *Your taste will prove that!*

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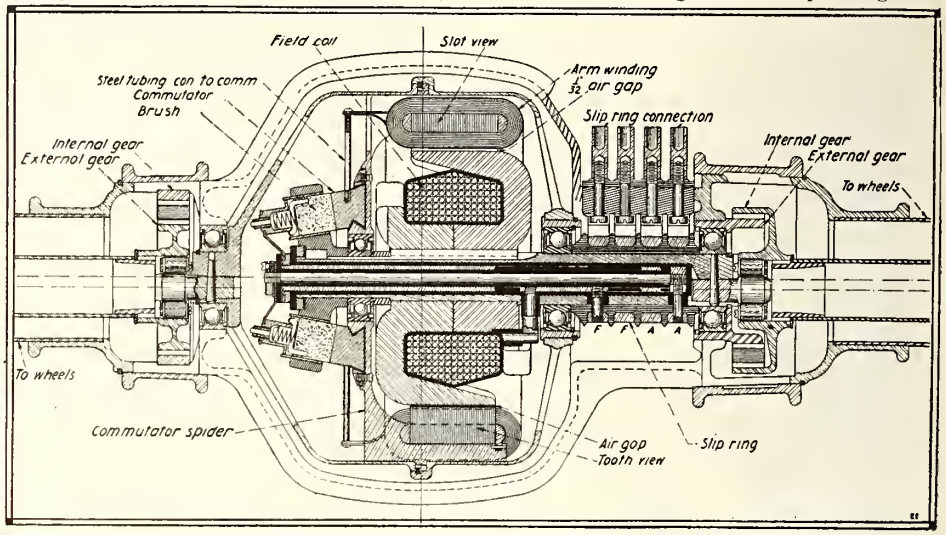
Camels are unlike any cigarette you ever smoked. For instance, they leave no unpleasant cigaretty aftertaste or cigaretty odor. In fact Camels are in a class by themselves! That's why we ask you to *compare Camels with any cigarette in the world at any price!* You will not look for or expect premiums, coupons or gifts. *You'll prefer Camel quality!*

R. J. REYNOLDS TOBACCO COMPANY, Winston-Salem, N. C.

A New Era Electric Auto

(*Continued from page* 523)

charge. On this basis, for every pound weight saved in mechanical construction an additional pound can be saved in the battery weight; thus it can be truly said that "one pound saved is two pounds earned." The total weight of the rear axle, which includes the entire power plant, is approximately 100 pounds; which is several hundred pounds lighter than any other known to the writer; air springs will save 50 pounds; the wood frame with truss rods accounts for another 75 pounds. These savings are all duplicated in the battery weight, and are only a few of the many savings thruout the car that enables it to be produced at such record light weight, considering its size; but lightness begets lightness, and that is the whole secret.



Sectional View of the New "Dey" Electric Automobile Motor Which Has a Revolving Field as Well as Revolving Armature. This Motor Fits on the Rear Axle, Each Revolving Unit Driving One Wheel. No Differential Gear Is Necessary.

The inventor has largely increased the future field for his car by designing a *portable charging plant*, weighing only about 100 pounds, to be carried under the bonnet of the car. It comprises an exceptionally neat four-cylinder, four-cycle air-cooled engine, minus its flywheel; it is direct connected to the ring armature of a dynamo very similar in design to the motor; its field, however, is stationary. The cylinders of the engine are made of steel tubing, the cooling flanges of which are machined on by rotating the cylinders before a gang of milling cutters that cuts all in one operation. The flanges being formed in this manner permits doubling or tripling the radiating surface, as compared with cast cylinders. There are a number of other special features about the cooling arrangements that should produce an exceptionally well cooled engine, even if we did not consider the small size; for it requires less than two horsepower to meet the power consumption requirements on the road. With this combination the mileage per gallon will be at least *twice that of a gas car;* due to the engine always running at its maximum efficiency load, while a gas car does not average one-tenth of its rating; making its efficiency very low, probably not one-tenth of its best. The experimental car, which weighed 400 pounds more than the commercial vehicle, will *consume less than two electrical horsepower when running at 23 miles per hour* on level dirt roads. Hills will not appreciably change the figures for an average, for there are as many downs as ups in a round trip, and unless a grade is steep enough to make a demand upon the brakes the excess force of gravity will be stored in the form of momentum; and in the Dey Electric the motor converts its braking power into electricity that is stored in the battery; so there is very little loss due to hills, regardless of how steep their grades.

This plant will charge the battery at any time, while the car is running or standing. An automatic device stops the engine and opens the charging connection whenever the battery becomes fully charged. The dynamo acts as a starter when charging is desired. If short runs are the rule, *the plant can be removed from the car and used as a stationary charging plant for both the car and a stationary battery for house lighting.* It is a simple matter to replace at any time for long-distance touring. With the generating outfit aboard one-half of the battery equipment can be dispensed with, thus making a net saving in the weight of the car exceeding 100 pounds. The cost of the plant will also be largely cancelled for the same reason. When ladies drive it will probably be mainly as a plain electric; there is nothing, however, to prevent them using the engine, for the turn of a switch will set it going with a pep not equaled by any self-starter. The operation will be as quiet as any automobile engine.

$1000.00 Reward! For a Single Word

Can you create the one word which will best denote the United States and all parts of Britannia? If so, you will be paid at the rate of $1,000 a word. The World Trade Club of San Francisco has offered $1,000.00 to the person who suggests the word which, in the judgment of the club's Metric Campaign Committee, is best adapted to world-wide use.

The competition is open to all humankind. The money will be paid to the winner at noon on the 15th of May, 1920, by a committee appointed by President W. H. Hammer of the World Trade Club.

"Brit-Am," "Ambria," Ambrittica," "Brit-Am," "Sam-Bull" are some words thus far suggested. New names are constantly coming. The World Trade Club is offering this award because in carrying on its present compaign for the adoption of metric units by all English-speaking people—the United States, the British Isles, Canada, Australia, New Zealand, Tasmania, United South Africa, and so on—it was hampered by the lack of a single short word which would express all these.

The metric units of weight and measure are now used by all the world except "Brit-Am" or "Ambrittica," or "Sam-Bull."

Legless -- He Drives Auto Skilfully

(*Continued from page* 530)

both sides of the car are electric chime bells, which may be rung from conveniently placed push buttons, and the car is thoroly equipt with electric lights, both inside and out. Moreover, not only is this car used for pleasure purposes, but it is also used to economize on the High Cost of Living. The car is equipt with two small stoves on which the cooking is done, the fuel for the same amounting to about 10 cents per week. All cooking utensils are placed in a very tidy position, as neat as any housewife would care to have them. There is a collapsible bed, which can be stretched out and slept in with ease and comfort. This, too, is so arranged that a small tent, which is always carried, may be pitched in some open field on the road from here to "somewhere West," and the bed removed from the car and made use of in the tent. And talk about other comforts, you'll find the machine fitted with an electric fan and dozens of smaller items too numerous to mention, such as a clothes rack, medicine chest—in fact, anything which a small modern home can make use of. According to Mr. Hammel, the only thing that is lacking is a "wife."

Perseverence is the thing that counted. Mr. Hammel has obtained his chauffeur's license after being placed under the most excruciating quizzes which the State License Bureau could possibly give. So cheer up, all you individuals without the use of limbs. This device has been patented and placed on the market, so you will have no difficulty in mastering the science of automobiling, tho legless, and may enjoy your rides without the expense of a chauffeur.

WAR IDEAS SENT U. S. FROM ALL OVER WORLD.

The latest war secret to leak out is how friendly inventors from all over the world gave to the United States their ideas for death-dealing machines for the destruction of Germany.

A companion secret is how all these ideas were kept from the enemy by the "seven serious sphinxes" of the Patent Office. This was a board of seven men, of unquestioned loyalty and sworn to secrecy, empowered to examine and withhold patents on war machines until the war was over and meanwhile turn ideas of promise over to the Government.

Among the spectacular inventions were the depth bomb, submarine signals, and devices for air photography. The committee approved a patent for the special leather for trench shoes, designed to resist the mud and water. It also approved a patent for special alloys for use in steel tools to turn out shells. Patents for wireless and aiming machine guns from airplanes were past upon.

More than 2,000 devices which it was thought might be of value to the United States or the Allies were past upon and 200 were important enough to get before military authorities. Some of them, it is said, helped win the war.

The ideas came from England, France, Switzerland, Hawaii, New Zealand, Australia, Mexico, Spain, Italy, Russia, Poland —*and one from Germany!* Of course, a larger number came from within the United States. Now that the war is over, the patents are being allowed.

Patent Commissioner Newton's committee included five who were West Point or Annapolis graduates, being Sidney Smith, A. E. Glascock, J. H. Colwell, F. W. Holt and F. C. Skinner. They were assisted by A. C. Lewers, chemist, and William J. Rich, metallurgist.

SPIDERS TIE UP CABLES.

Spiderwebs are working havoc with cable communication between the United States and Argentina, Brazil, and parts of Chile, as well as paralyzing interior telegraphic routes. The ground spider spins a heavy web which the wind sometimes wraps around the wires. These masses become very damp during a humid spell and short circuits are thus caused.

Large forces of linemen have to follow the wires across the Pampas and the mountains, removing the accumulations.—[When you meet spiders 9 to 10 inches in diameter and weighing a pound or two, you may expect "trouble" somewhere.—ED.]

PHOTO COURTESY CORRECTION.

We wish to make a correction in giving courtesy for the article entitled "NC Planes Had Electric Self Starters," which appeared on page 411 of the September issue, and which was credited to The Westinghouse Electric and Mfg. Co., in error. This credit should have been given to the General Electric Co., and the makers of the Liberty motor electric starter used on the NC planes in the trans-Atlantic flight to Europe, was the Bijur Motor Appliance Co.

Investigating "Psychical Phenomena With Scientific Instruments"

(*Continued from page* 521)

convinced of the reality of these phenomena,—was busy devising an instrument which would register and direct *psychic power* liberated from the body of a physical medium when in trance.

Dr. Imoda, the assistant of Professor Mosso, has also conducted a number of experiments in the discharge of an electroscope, by means of "rays" issuing from the medium's body. It was found that, if the medium held her fingers at a distance of an inch or so from the knob of the electroscope, some form of energy, apparently *radio-active* in character, issued from her fingers, and *gradually discharged the electroscope*. This is the "radiation" or "emanation" issuing from the body, which has been studied extensively by students of the occult. Dr. Imoda concluded—as the results of his experiments—that *"the radiations of radium, the cathode radiations of the Crookes' tube, and mediumistic radiations are fundamentally the same."*

Some other very interesting facts have been observed, by means of the electroscope. For example, Dr. W. J. Crawford (D.Sc.), in his experiments, noted that:—

". . . In séance rooms where tables are moved without physical contact, I found that after a sitting was well started, I was always *unable* to charge an electroscope, even tho I tried to do so in the corner of the chamber farthest from the medium. In order to charge it I had to take it outside the room. I asked the 'operators' (intelligences 'running things,' apparently, in the séance-room) if there was any 'power' in the séance-room so far away from the medium, and they answered in raps that there *was*. By 'power' I understand them to mean particles of matter taken from the medium . . ."

Again, in his "Reality of Psychic Phenomena," he says:—

"I took the electroscope to the table in the corner; then placed it in the circle near the medium. I asked the operators to touch the disc of the instrument very gently. They did this almost at once, the 'touching' consisting of a metallic scraping upon the brass disc, quite audible, similar in type to the imitation of the floor being rubbed with sand paper, a phenomenon I quite often observed. (*Continued on page* 571)

Making a Machine for Telegraphing Pictures

By Leroy J. Leishman

(Continued from page 533)

or wires which are in turn connected with the shaft. E is a narrow piece of metal also connected with the shaft. F is a metal band much wider than E which extends around the cylinder from one side of E to the other, but does not touch E, as E and F must be insulated from each other. G, H, I, J and K are brushes. J touches both E and F as the cylinder revolves, but K touches F only. L and M are binding posts to which the wires are attached that come from the distant machine. N and O are the binding posts of the particular picture *transmitting* machine to which the synchronizer is attached. H and I are connected to two solenoids into which the horns of an iron rocker arm protrude. There is sufficient friction in the pivot of this rocker arm to keep it from turning excepting when the solenoids are energized. U is a rheostat with which a brush on the rocker arm makes contact. V is also a rheostat, and W is resistance in series with the motor. T represents the electro-magnets of a gravity relay, the arm of which rests against the stationary contact Z until T is energized, after which it rests against the contact Q. R, S, P is a two-way battery switch. X is a motor that is geared down to operate the picture transmission machine proper. The electrical connections are all shown in the diagram.

If this type of synchronizer is to be used, one must be made for both machines. The particular advantage of this type over all others which require no additional line wires lies in the fact that the cylinders are permitted to revolve continuously and are not stopt momentarily each time a revolution is made.

Now let us see how this synchronizer operates. With the arm of relay T against Q, we adjust the rheostat V so that the motors X of the sending and receiving machines run as nearly as possible in synchronism when the contact of the rocker arm is in the center of U. The synchronizer is now ready to operate.

Of course, we have not yet explained how a picture is prepared or transmitted, but you know that the needles on the carriage arms must be in contact with the cylinders. Until the machines are running in synchronism, we therefore do not let the needles rest on the pictures, as everything transmitted before synchronism is establisht would be distorted beyond recognition.

On the sending outfit put the arm of the gravity relay against Q, and put the two-way battery switch on S. The motor of the sending machine is now started, and by studying the diagram you will see that a circuit is completed every time B and E come in contact with G and J, respectively, causing an impulse to be sent over the wire once every revolution. Start the motor of the receiving machine with the relay arm against Z, and throw the battery switch to R. This motor is now going slightly slower than that of the other machine, because it is in series with the resistance W. The motor of the sender is not in series with its resistance, as its relay is against Q instead of Z. On account of the slower motion of the receiving cylinder, the brushes are on a different part of the circumference of the drum A each time the once-every-revolution impulse comes from the sending machine. The brushes H and I are therefore finally on C and D when this synchronizing impulse comes. This causes the current to go thru the solenoids and the relay T, the arm of which

is pulled from Z to Q, thereby cutting out the motor resistance so that the motor will of its own accord run at the approximate speed of the motor on the sending apparatus.

The accurate synchronizing now goes on automatically. You will remember that the current to the resistance pieces C and D comes from metal strips on opposite sides. When the synchronizing impulse comes in, when H and I are in the exact centers of C and D, the currents in H and I are therefore equal. The solenoids also receive equal current and keep the rocker arm in the center of U, supplying the motor with a uniform amperage. If the receiving machine gets slightly behind or ahead of the sending machine, the brushes H and I will be slightly above or below center, and one brush will be nearer the metal strip which supplies the current to the resistance, and the other brush will be further away. One brush, therefore, carries more current than the other, and one solenoid will pull harder than its companion, causing the rocker arm to change its position on the rheostat U, thereby correcting the speed of the motor. The function of E, F and K is to distribute the current alternately to the synchronizer and the picture machine proper.

If this synchronizer seems too difficult or costly to make, the other synchronizer may be used or else the rod connection employed. In the latter case, your picture transmitting set will have been very easily and inexpensively constructed, and the degree of excellence of the received pictures will not be lessened in the least.

The machines are now ready to be adjusted. When sending, the needle in the carriage arm may have a play of as much as a quarter inch. It must at all times touch the cylinder, and should there be any sort of bulge in the rolled transmitting plate, this much play is necessary so that the bulge will not raise the needle beyond its play and throw the half nut on the bottom of the carriage out of mesh with the threads on the shaft. For receiving, the needle must be very delicately adjusted. It must rest on the cylinder when the magnets are not energized, and when raised up, it should be just high enough to clear the cylinder at all points on its circumference. The less upward and downward motion the needle has the faster it will operate and the better the pictures will be.

Extend a wire from one of the binding posts of one instrument to one of the binding posts of the other. The remaining posts must be connected to the batteries—preferably two dry cells. If the last explained synchronizer is used, these wiring directions may be considered to apply to the synchronizer binding posts instead.

TRANSMITTING PICTURES

Before transmitting *half-tones*, you can write or draw with shellac upon a thin metal plate and transmit this. After the shellac is dry, roll the plate into a cylinder and slip it over the cylinder of the machine you are going to use for transmitting. Place the edges at the top of the cylinder with the overlapping part of the cylinder toward the carriage, and if the plate is put on as explained the overlapping edge will not strike the needle and cause trouble. Put heavy rubber bands around the ends of the plate to hold it firmly against the cylinder.

RECEIVING THE PICTURES

To receive the picture, you will need a sheet of ordinary white paper and a piece of pen carbon paper. The carbon sheet goes on the cylinder face down around the white paper. If the rod connection or the first explained electric synchronizer is being used, be sure that the edges of the paper are placed at the top. If you are using the synchronizer which requires the extra cylinder or drum, the edges of the paper when placed on the picture cylinder should be in a straight line with the resistance pieces and the copper strip. This also

applies to the copper sending cylinder. Overlap the ends of the paper toward the carriage, the same as you did with the plate. If you should carelessly overlap it the other way, the needle will catch the edge of the paper and tear it off. Be sure that the carbon sheet fits *tightly* against the white paper. Secure these to the cylinder with rubber bands.

Put the carriage at one end of the cylinders with the needle in contact with the same. Now place the switch on your sending instrument at the right and on your receiver at the left. Start your motors, or else turn the cylinders with a crank. As before mentioned, the speed should be about one revolution in three seconds.

By the time your carriages have advanced to the other side of the cylinders the picture is finished. As long as the needle of the transmitting instrument is on bare copper, the current flows, energizing the electric magnets of the receiving carriage and causing the needle to be raised out of contact with the carbon paper. Whenever the shellac comes under the needle the current is broken and the spring holds the receiving needle against the carbon paper, thereby making a mark. In this way the transmitting of the entire picture is accomplisht.

In the inexpensive sets that I mentioned having designed for the market, half-tone pictures are supplied already prepared on copper for transmission; but there is some satisfaction in having them prepared yourself. Any photo-engraver can do it. You should have a photograph without too much detail and with considerable contrast—that is, black and white. Better results are possible if the photograph has a glazed finish. Obtain a sheet of thin polished copper of a size that will roll to fit the cylinders. Tell the engraver that you want him to proceed as if he were going to make a half-tone on this copper plate, but that he must stop after he has cooked his gelatine to a dark chocolate color. *It must not be etched.* Tell him you want the screen to be no finer than 25 or 30. He undoubtedly will have no screen this coarse, so instruct him to make a small zinc half-tone cut of 40 or 65 screen, and to make a print from this. Then have him make an enlargement of this print, *without his screen,* until he has the 25 or 30 mesh which you desire.

This plate is rolled and the picture transmitted just the same as the shellac drawing.

Pictures do not have necessarily to be received with carbon paper. Your apparatus will permit the use of a few other methods. Smoked paper or wax-coated paper will do. If the former is used, however, the received picture will be a negative unless a negative is used for transmitting. Various other plans of receiving may be experimented with and will be found very interesting to the experimenter.

Pictures may be received without any carbon paper by turning the switch of the receiving machine to the right or sending position and utilizing a sheet of paper soaked in a solution of the following proportions:

Nitrate of ammonia, 4 pounds; ferricyanid of potassium, 1 ounce; gum tragacanth, 4 ounces; glycerine, 4 ounces; water, 1 gallon.

The paper should be kept moist while the picture is being received. Like the smoked paper, this produces a negative when a positive is being used for transmission, and a positive when a negative is being sent. These visible ways of recording make a much more interesting demonstration, altho the picture is not as good.

Of course, there are ways to telegraph pictures which are radically different from those explained here, but only the simpler ways are given so that the apparatus can be constructed easily and cheaply.

The experimenter will find telephotography a very interesting, instructive and fascinating field.

Investigating "Psychical Phenomena"

By Hereward Carrington, Ph. D.

(*Continued from page* 566)

"*Result:*—On examination, the electroscope was found to be completely *discharged!*

"I took the electroscope to the table in the corner of the room and tried to recharge it, but found I was unable to do so even after repeated trials. Accordingly I asked the 'operators' to put back into the body of the medium the matter they had taken out (for the production of the sledge-hammer blows) and to give a few raps when they had done so. In a minute or two some *very light raps* were given, and when I asked if the process was complete I received *no raps in reply at all,* which seemed to indicate to me that all the matter used for rapping had been returned to the medium. At any rate, I found that I could now charge the electroscope; which done, I placed it on the floor as before within the circle, and asked that the disc should be touched lightly. After a little time, there was the metallic scraping as before, and on examination the electroscope was found to be completely *discharged.*"

It will be at once apparent to the reader that two problems confront the investigator, when once he is called upon to solve such problems as the above: (1) the *physical miracle* itself; and (2) the nature of the *intelligence,* lying behind and directing or controlling the manifestations. This latter is called a *psychological* question, which, immensely important as it is intrinsically, does not enter into the *physical* problem. It need only be said that this is *the* baffling question in psychical investigation, and the most puzzling. Whether it be an independent "spirit," as it claims to be; or the subconsciousness of the medium; or whether it is a sort of compound consciousness, made up of the collected minds of those forming the circle at the time; or whether still other interpretation is open to us—this is all a moot question, which is referred to here, merely to draw the reader's attention to the fact of its existence.

It will be at once apparent to the reader, also, that physical and electrical apparatus has played an important part in such investigations, in the past, and is certainly destined to occupy a far more important place in the future. These curious phenomena—like all others in our world—depend upon invisible forces or energies for their production. Those interested in electricity should realize, more than all others, the power of the invisible; and the fact that *the invisible is the real.* Anything that we see consists merely in a bundle of "phenomena"—of *effects.* The real cause is always behind, and is always invisible. Thus, there is an old saying that "No man hath seen God." But it is equally true that "No man hath seen man." We see his clothes; these can be changed. We see his face and features; even these can at times be camouflaged! But the real man, the Self, the Ego, is something within,—invisible, intangible,—the directing and guiding power, which in life we know as the "Person."

There is nothing inherently absurd or impossible, therefore, in these odd manifestations,—however bizarre and unusual they appear to us at first sight. An unusual combination of circumstances might bring them about. Stones do not ordinarily fall out of the air; yet at times they *do* (meteors). Water does not usually rise above its own level, yet it can be made to do so. The curious freaks of lightning are well known. There is nothing inherently impossible, therefore, in supposing that a

table can be "levitated" into the air, under unusual conditions; it is simply the manifestation of an unknown energy—of which, doubtless, there are many. We can manipulate and control the electric current; but we do not know yet precisely what it *is*. Similarly, we can study the effects of many of these curious biological forces, without understanding their true nature. Above all, it behooves us to keep an open mind, and not to cry "impossible," just because we have never seen such facts, or because they appear to us innately improbable.

Here, as elsewhere, we depend upon hidden and unknown energies. Could we but find *an energy common to the two worlds*—the spiritual world and the material world—we should have here a means of direct communication, possibly by instrumental means. *Delicate physical and electrical apparatus may be the means, after all, by which such communication will ultimately be established!* At all events, when subtle causes and forces are in operation (as they doubtless are during a séance) it is only natural to suppose that instruments, *far more delicate than our senses*, should be the logical method of detecting them, and, as yet, such experiments have rarely been attempted.

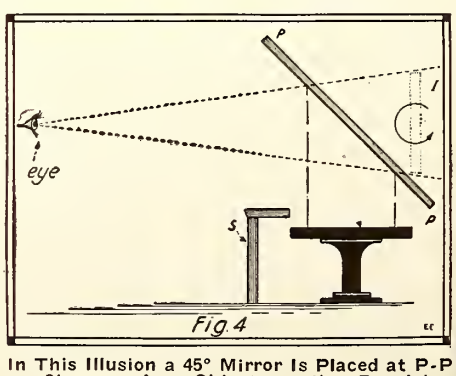
When we take into consideration finally the electrical theory of the nature of matter; when we remember the many striking analogies between electricity and the life-force; when we remember that the science of electricity is yet in its infancy, it should hold out to us the hope that, *here*, we may find a solution of many of these obscure problems, and that further investigations in the field of electricity may serve to explain to us many of these unknown and mysterious secrets of our inner nature, and the still more mysterious secrets of the séance-room. No more interesting and profitable researches could be attempted than those which endeavor to establish a connection between known and unknown phenomena; between physical and electrical manifestations, on the one hand, and these curious "psychical" phenomena, on the other. I hope that a number of readers of this article may see their way clear to try experiments in this direction, and to publish their results.

Experiments in Physics

By John J. Furia, A.M.

(*Continued from page* 531)

After the performer has stept into the cage and the door is closed, he pulls in the mirrors as in B. When the door is opened again he is hidden behind the mirrors, while the *mirrors reflect the sides of the cage* out to the audience, giving the illusion that *the back of the cage* is seen. On pushing the mirrors back into place again while the door is shut the performer again comes into the view of the audience when the door is opened.



In This Illusion a 45° Mirror Is Placed at P-P as Shown. Any Object on the Revolving Table "T" Appears to Be Rotating in Mid-air at a Point in Space "I".

So far the illusions described have been of the *virtual image* class. The audience has seen an *unreal* image. The real image class is not used as extensively. The following is an illustration of this type. A fragrant odor meets the nose, a beautiful bouquet is seen in a handsome vase. One gets nearer and nearer to the vase and the bouquet has—disappeared! Figure 6-C

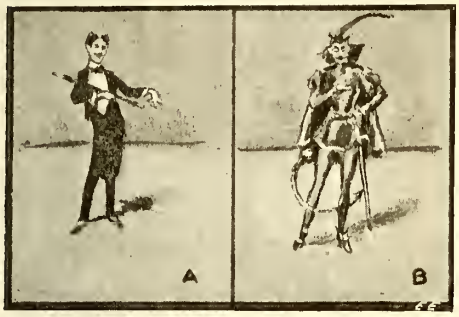


Fig. 3. The Performer Mystically Changes from His Evening Clothes to a Devil's Costume Before Your Very Eyes—Thanks to the Lighting Stunt and Glass Screen Shown in Figures 1 and 2.

tells the story. An empty vase A is placed on a hollow box. Inside the hollow box hangs a bouquet unside down. A concave mirror M, directly in front of the eye, is concealed by its dark surroundings. The mirror forms a *real image* of the bouquet, and by moving the mirror to the proper distance and tilting it to the proper angle this image can be formed just at the right point on the vase as to give the appearance of the bouquet being actually in the vase. As one moves out of the line of the vase and mirror, the image is no longer seen and the flowers have disappeared.

The subject of illusions is a vast one, and in a short article of this kind one can only "hit the high spots." In detecting illusions always look for mirrors and polished surfaces.

(To be continued)

To Europe In Three Hours

By H. Winfield Secor

(*Continued from page* 514)

what a difference the body and its organs have to accustom themselves to in this short time, and it is small wonder that the pilot can hardly stand the rapid atmospheric changes occurring. Ascending to an altitude of 40,809 feet in another official test which the weather bureau has conducted, and utilizing a pilot balloon with scientific instruments attached for recording the atmospheric constants, we find the air pressure here dropt to the low figure of 2.69 pounds per square inch. At 60,000 feet elevation above sea level, the official figures show but 1.17 pounds per square inch. At 88,000 feet, 16.7 miles above sea level, the recorded air pressure is .3146 pounds per square inch, or approximately 5 ounces. Let us now jump to a real high altitude—100,000 feet, or 18.9 miles above good old terra firma at sea level, where we find but a fraction of a pound, or 3.05 ounces (.91 lb.) per square inch, atmospheric pressure. Even a flea could not live up there, we will wager, except that it is in a vacuum bottle, and a strong one at that. The highest figure to which a test balloon carrying recording instruments has flown is 126,800 feet, or 24 miles above sea level. The pressure at this dizzy altitude is but a fraction of an ounce.

The various degrees of cold found in recent tests, most of which were carried on during the summer months, are tabulated

in the accompanying illustration, and these exert a very severe effect on the pilot indeed, covering his glasses with frost, so that it is impossible to see the instruments and steer the plane, even at altitudes of 25,000 feet and less; causing the engine to misfire, and in fact to stop in many instances. Electric self-starters which are now being fitted to most of the sea and land planes help the pilot out of many difficulties such as this, which may otherwise end disastrously for him.

To Europe in Half a Day by Airplane.

If we have an airplane which can go over 200 miles an hour, such as the "Christmas" Bullet plane, and ascending to an elevation let us say of between 30,000 and 40,000 feet, where we had an air current traveling Europeward at 200 miles an hour, then our net speed upon reaching this strata would total 400 miles an hour. With a "vacuum bottle" cab fitted to the airplane, together with oxygen tanks and atmospheric compressors for the carburetor system of the engine as well as for the cabin, it would then become possible to fly the 3,000 miles separating New York and London in approximately *one-half day or seven and one-half hours.* Possibly in flights of the future, when aircraft will abound in large numbers, there will be a strict classification of the air strata, such as shown in the accompanying drawing; the lower strata being assigned to the slow-going and shorter trip airships—the middle strata to the speedier open-cabin planes or dirigibles; and finally, the upper highly rarefied, rapidly moving air strata to the specially protected aircraft engaged in negotiating long distances, such as trans-oceanic and trans-continental trips, where speeds of 400 to 600 miles will be not only frequent, but common. The passengers will hardly realize that they are traveling at such prodigious speeds, owing to the fact that one of the principal components of their relative velocity to the earth will be the air current in which they are moving. If the plane had to tear its way thru the air, so that air currents had to rush by the edges and surfaces of the machine at a velocity of 400 to 500 miles an hour, the terrific air friction would probably injure the craft speedily; however, when the plane is actually cutting thru the air at 200 miles an hour, and the air current with which it travels is going at an equal speed, then no abnormal air friction will be encountered.

Around the Earth in 24 Hours by Airplane.

If we can devise an aircraft with large enough wings to support itself, sufficiently large multi-bladed propellers, compensated engines and proper crew housing arrangements to survive the extremely rarefied atmosphere at an altitude of forty to fifty miles (which is in the region of the limit of the earth's atmosphere, as our scientists tell us), then it is possible that the aviator would meet with air currents of such high velocity that he would be able to practically shut off his power and travel 25,000 miles (generally speaking) in 24 hours. Why is this so? Due to the fact that it is known from kite and balloon sounding tests in the upper atmospheric air strata, that many miles above the surface of the earth there are air currents moving eastward, and probably some of them westward with the rotation of the globe, or 1,000 miles per hour. Prof. McAdie, a noted American meteorologist, Harvard University, has estimated that such high velocity air currents may be encountered at even 50,000 feet. Considering that such a high velocity air current is found at 50,000 feet, then he considers that above this there may be a *westward-moving* air stratum, and still higher another *eastward-moving* air stratum. These phenomena were attested very markedly by the high altitude flight of Major R. W. Schroeder, of the American

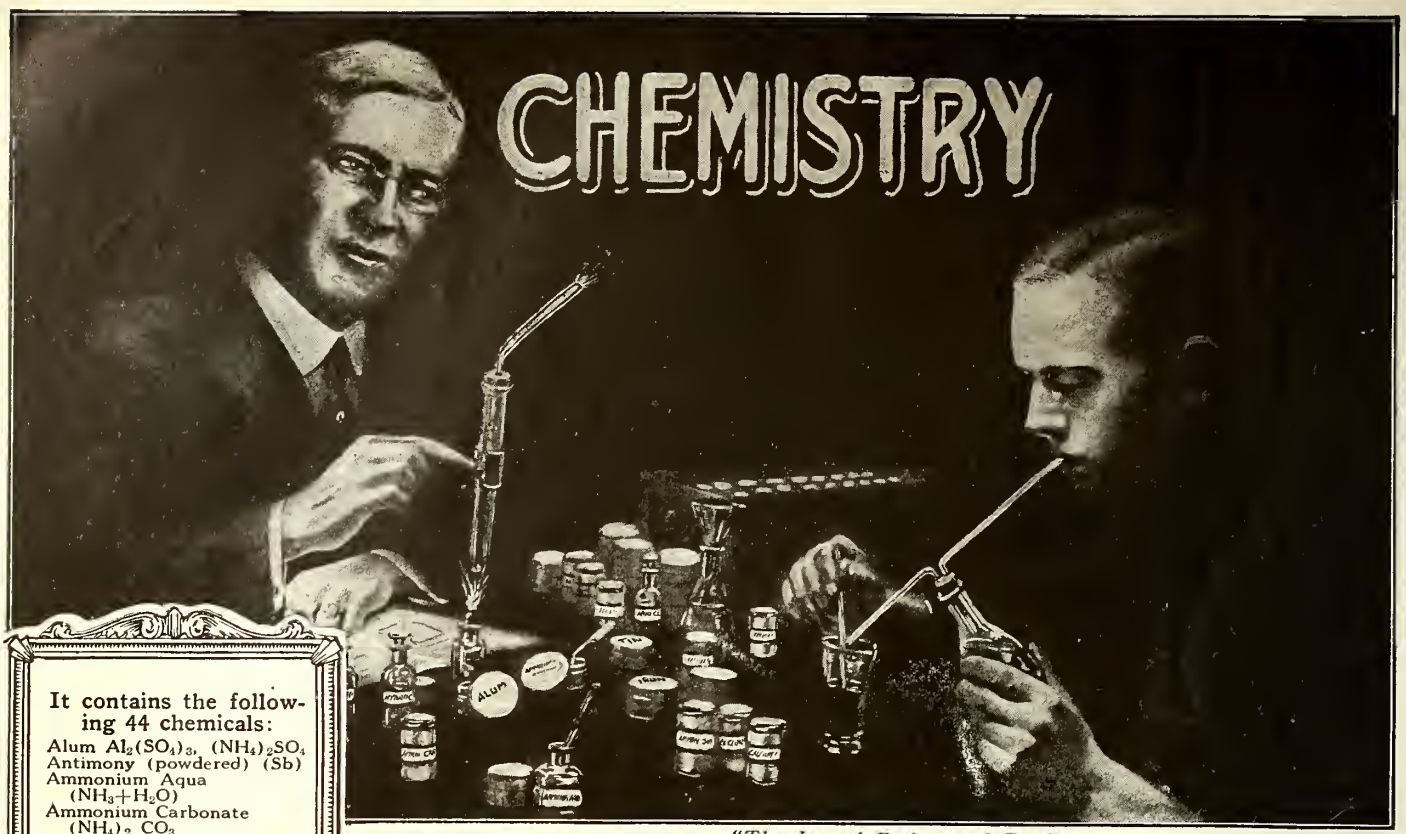
Flying Corps, who found himself carried 200 miles *east* of the location from which he had ascended; and not only this, but with his plane traveling *west* at 100 miles an hour, the great eastward moving air current must have had a velocity of more than 300 miles an hour, or it would not have carried him 200 miles *eastward* from where he ascended. Thus do we learn more and more daily of the uncharted wonders of the great translucent envelope surrounding our earthly habitation, which we call the "atmosphere."

High Altitude Flying Machines.

What type and form of aircraft will the high altitude machine be? This question was answered in part by the above discussion, where it was mentioned that the machine intended to fly at altitudes of 40,000 feet or over would be necessarily equipt with wings of much greater sustaining surface or else a triplane or quadplane could be employed. Also in order to "get hold" on the thin rarefied air of the higher strata, longer propellers would be necessary, and preferably also an increase in the propeller speed. It should be remembered that while the air has become lighter and less dense at these high altitudes that the weight of the plane and aviator has remained practically the same, the slight loss in weight due to the change in gravity pull, occasioned by going away from the earth's surface, being very small and having no practical bearing on the matter. Balloons have ascended with passengers as high as 38,000 feet. The heat of the sun rapidly expands the gas in balloons, and they also expand markedly at such altitudes, due to the reduced air pressure. At a height of 70,000 to 80,000 feet a pilot test balloon (no passengers) *will expand to about four times its normal size.* The air pressure acting on the balloon bag has fallen decidedly; so the hydrogen gas with which it is filled pushes outward on the envelope to a proportionate extent. Many times these weather bureau pilot balloons burst before they have reached the altitude intended for these reasons—heat and rarefication of the atmosphere. The large passenger-carrying dirigibles, containing gas to make them buoyant, such as the R-34, which recently crost the Atlantic ocean and return, have special compensating valves which release some of the gas at intervals as the airship ascends—losing about 1/30 of its volume of gas for every thousand feet of "climb."

What does this demonstrate? Simply this: that what gas is lost by heat and rarefication expansion by ascending cannot be recovered. Therefore the balloon must carry sufficient gas to permit its remaining buoyant when it descends again to a denser or lower atmospheric strata. A certain amount of expansion in a non-rigid or even in a rigid balloon or dirigible is permissible and desirable, as this increases the surface area exposed to the atmosphere; therefore the lifting power is maintained, within certain limits, in the less buoyant and highly rarefied air. It is conceivable, therefore, that as the rarefaction of the air increases very rapidly as we rise to greater altitudes than 40,000 feet above sea level we shall probably find our dirigible altitude airmen confined to air strata below 40,000 feet. This seems logical, for the reason that to ascend much above this air level a very considerable amount of gas would have to be liberated to prevent the balloon expanding to the bursting point, and therefore the gas so lost would apparently soon reach the limiting point where no more gas could be liberated, or else the dirigible would not retain a sufficient volume of gas to give it the necessary buoyancy to hold the weight of the crew, cabins, engines and fuel. A pilot balloon as used by the Weather Bureau for testing purposes is a simple spherical and easily expansible af-

(*Continued on page* 596)



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Ammonium Chloride (NH_4Cl)
Ammonium Sulphate $(NH_4)_2\ SO_4$
Barium Chloride $(BaCl_2)$
Boric Acid (H_3BO_3)
Brimstone (Sulphur) (S)
Calcium Chloride $(CaCl_2)$
Calcium Oxide (CaO)
Calcium Sulphate $(CaSO_4 2H_2O)$
Charcoal (Carbon) (C)
Chloride of Zinc $(ZnCl_2)$
Copper Sulphate $(CuSO_4)$
Ferrous Sulphate $(FeSO_4)$
Ferrous Sulphide (FeS)
Glycerol (Glycerine) $C_3H_5(OH)_3$
Hydrochloric Acid (HCl)
Iodine (I)
Iron Chloride $(FeCl_2)$
Iron Oxide (Fe_2O_3)
Lead Acetate Pb $(C_2H_3O_2)_2$
Litmus Paper
Magnesium Carbonate $(MgCO_3)$
Manganese Dioxide (MnO_2)
Mercury (Quicksilver) (Hg)
Nickel Chloride $(NiCl_2)$
Oxalic Acid $(H_2C_2O_4)$
Sodium Bicarbonate $(NaHCO_3)$
Sodium Borate $(NaBO_2)$
Sodium Carbonate (Na_2CO_3)
Sodium Chloride (NaCl)
Sodium Nitrate $(NaNO_3)$
Sodium Phosphate (Na_2HPO_4)
Sodium Sulphate (Na_2SO_4)
Sodium Sulphite (Na_2SO_3)
Stannous Chloride $(SnCl_2)$
Sulphate of Nickel $(NiSO_4)$
Sulphate of Zinc $(ZnSO_4)$
Sulphuric Acid (H_2SO_4)
Tin (Granulated) (Sn)
Zinc (Metal) (Zn)
Zinc Carbonate $(ZnCO_3)$

The following apparata are furnished:

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One Glass Funnel
One Delivery Tube
Six Assorted Test-Tubes
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A good part of the book is devoted to Weights and Measures. The Metric System, the English system and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

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In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Combination Salt and Pepper Shaker.

(340) Messrs. Frank B. Martin and G. L. Pastor, Braddock, Pa., submit what they call a combination salt and pepper shaker. The idea is to use the two vessels side by side, and then by having a sliding member with holes, either salt or pepper may be shaken out from either vessel as desired. Our advice is asked on the invention.

A. This is a capital idea and should prove a success. We are certain that a patent can be obtained upon it, and that the article when made properly will prove a good seller.

Multiple Phonograph Record.

(341) Jackson Lloyd, Long Beach, Calif., would like to know whether a patent can be obtained on a phonograph record which has four pieces on it, two on each side. The idea is to use a double track, similar to a double thread on a bolt. This would require the record to be twelve inches in diameter to hold the same amount, or the same length, of music as on a ten-inch record. The starting operation would be accomplisht by placing the needle in a groove, which would have to extend out into the smooth rim while the machine was not in operation. It is then started going.

A. There is nothing new about this device, and no advantage is gained because each piece would take up a certain amount of the record, and you might just as well have the second piece after the first was played. This is the present mode of doing it, and is perhaps more satisfactory than the suggested manner, which has been tried out in the past and found unsatisfactory.

Electric Shutter Trip.

(342) Lewis H. McCarrow, San Diego, Calif., would like to have our advice on an electric shutter trip for cameras to be used as a cable release operated shutter. Drawings accompany the request.

A. Nothing fundamentally new is shown in this device, and while no doubt it will work, there is nothing new contained in it that would warrant our correspondent to obtain a patent.

Pliers.

(343) B. F. Freese, Williamsburg, Pa., submits description and illustration of a combination electrician's pliers. Several new improvements are shown, where the jaws of the pliers have several different sizes of openings, which are used to remove insulation from different gage wires. Our opinion is asked as to patentability, etc.

A. We can offer no encouragement to our correspondent on this idea. Nothing fundamentally new is shown, and we doubt very much whether a patent could be obtained.

Shuttle Alarm.

(344) G. L. Busse, Cedar, Minn., has conceived an idea to use an electric contact arrangement which gives an alarm when the thread on the sewing-machine bobbin becomes depleted. It is well known that many pieces of material are spoiled or have to be run over because the thread has run out from the shuttle bobbin when the person operating the machine was not aware that the thread supply had run low. Our advice is asked as to patentability and usefulness of this improvement.

A. This is a very good idea, and we think a patent can be obtained on the device. How practical it will be and how the women folks will take to it, is impossible to say. One advantage of the device is that it can be manufactured for a few cents and is readily attached to any machine. All that is required is a battery and a buzzer, and the whole outfit can be put on the market for $2.00. What success there would be in marketing the device, however, is problematical.

Cold from Electricity.

(345) Mr. Ernest F. Prucha, Howells, Nebr., submits an idea showing a net-work of bismuth and antimony bars, which are crost and soldered together in the form of a Peltier's cross. This is to be used to cool a room, etc.

A. There is nothing fundamentally new shown, and the principle is well known and quite old. No patent could be obtained, in our opinion.

Spark Plug.

(346) Frederick L. Umbach, Troy, N. Y., writes: "I have a small invention and would like to know if it is on the market. It is a low-tension make-and-break spark plug. No coil or magneto is used. All that is needed is a dry-cell battery to make the plug throw a large spark. I have tried this plug on gasoline engines, motorcycle and automobile engines, and it has worked with success. I have made a few and sold them to different men who have cars, and they have had good results with this plug, so that the carbon from the engine could not stop the sparking. I would like to know whether this could be patented, and wish to hear from you as soon as possible."

A. Not having more details on the invention, it is quite impossible for us to give any information on the subject.

Hat Covering.

(347) Alex. Yenyo, Johnstown, Pa., writes: "I would like to submit a plan for a rubber covering for a hat, which is to be made of thin soft rubber overlapping a quarter of an inch at the brim. It is shaped exactly like the hat so that it fits snugly over it, to protect it from the rain. When not in use, it can be slipt into the pocket or a case made to hold it. I would like to know if this idea can be patented, or if there is any such idea out."

A. It is quite an old idea and any United States army or navy officer will be glad to show you one of the coverings which he uses to cover his cap. Such rubber coverings are for sale in stores selling headwear to officers.

Talking Film.

(348) Donald Hucke, Sheldon, Iowa, writes as follows: "I have read so much of the impossibility up to the present time to obtain perfect synchronism between the motion picture machine and the phonograph. In the February, 1918, issue of the ELECTRICAL EXPERIMENTER, on the first page, the vibrations of the voice was recorded on a celluloid film. Couldn't this be applied to the edge of a regular picture film. If heat was needed for the talking record, it could easily be localized so as not to affect the film. Altho this would have to be recorded on each individual film sent out, this also could be easily done from the original. The difficulties of talking would be few. A phonograph recording attachment and a few sensitive microphones would be all. I have thought this over from every point and I can't see any objection to it that could not easily be remedied. Will you please put this on your "Patent Advice" columns of the E. E. and tell me whether it works or not.

A. This magazine has publisht quite a good deal about talking films in the past, and while the fundamental idea seems to be right so far, we have never seen the device work out in practise, presumably for the reason that the investigators have struck a snag. As to our correspondent's idea to put the phonograph record alongside of the perforation of the film, this would not constitute a patentable idea, nor would there be enough room for the voice, as far as we are able to ascertain.

Automatic Talker.

(349) A. B. W., Chicago, Ill., says as follows: Could you please advise me through the ELECTRICAL EXPERIMENTER whether or not I would be able to secure a patent on the following apparatus. The apparatus is an instrument which will automatically answer a telephone; that is, when the party being called is not at home; tell the party calling that there is no one at home and asking if there is any message which they would desire to leave, which, if there is, it will take it and reserve for the party being called. Upon the return of the party being called the same machine which talked to the incoming calling party will play off the message which has been received. The instrument is only set at times desired.

Here is an example of the machine having been connected. Machine answering phone: "Hello—Drexel 4368." "There is no one at home just at present. Is there any message which you wish to leave?" The party calling: "Yes. Please tell Mr. Jones that I would like very much for him to call Mr. Smith at Eng. 5346." When the calling party hangs up the machine automatically comes to a stop. Upon the return of the party being called they play off the record which has been made by the call.

The machine is connected in the home and is started by the incoming call.

A. There is nothing new to this device, it having been described a number of times in the ELECTRICAL EXPERIMENTER, as well as other magazines. The device is not impossible, altho we believe it is impractical, as, first of all, few people would go to the trouble of installing it, and the device would be unduly complicated in case two or three more people would call up in succession.

Electrical apparatus for tapping trees, which can be left without attention for months, has been invented.

For mines using electric haulage, a door opening motor and safety signal, operated by the drivers of mine locomotives, has been invented.

Practical Chemical Experiments

By Albert W. Wilsdon

(*Continued from page* 532)

Experiment No. 5. Since the acid potassium malate exists in the stalks of the common rhubarb, the juice that is exprest from this may be filtered and tested for malic acid by the method in Experiment No. 4.

Citric acid occurs in the juice of lemons, currants, unripe tomatoes, gooseberries, etc. It is made on a large scale from lime or lemon juice, by saturating the juice with chalk; the precipitat of calcium citrat is decomposed by an equivalent quantity of sulfuric acid and filtered from the calcium sulfate. Evaporate the filtrat and crystallize out most of the calcium sulfate, and from the mother liquor allow the citric acid to crystallize.

Experiment No. 6. Make citric acid from the juice of at least two lemons, as above described.

Experiment No. 7. Add a moderate quantity of calcium chlorid to a concentrated solution of citric acid, and then add sodium hydroxid till the solution is nearly neutral. Calcium citrat will be formed.

Experiment No. 8. Try the above test with a concentrated and filtered sample of lemon juice, and note the formation of the precipitat of calcium citrat.

Tartaric acid is found in many fruits, particularly ripe grapes, as acid potassium tartrate. When the "must" ferments the "cream of tartar" precipitates as the alcohol increases, and this precipitat is known as crude tartar. It is frequently much contaminated with calcium sulfate, which is used in "plastering" the wine. To make

tartaric acid from this, the solution of the argols (crude tartar) is treated with milk of lime to form the calcium tartrat, and the latter salt is suspended in water and treated with an equivalent of sulfuric acid, and the calcium sulfate so formed is filtered off, and the tartaric acid is obtained in crystals by concentration of the filtrate.

Experiment No. 9. Add to a concentrated solution of tartaric acid a concentrated solution of potassium chlorid, when a precipitat of potassium tartrat will be formed on shaking and allowing to stand at ordinary temperature. The test is more delicate if the solution is nearly neutralized with sodium carbonat before the potassium chlorid is added.

Experiment No. 10. Make a similar experiment with filtered grape juice, which may conveniently be obtained from canned grapes. A more delicate test is made by adding to 100 cc. of the fruit juice a few drops of concentrated acctic acid, a few drops of concentrated potassium acetate solution, and 15 g. of pure, finely ground potassium chlorid; dissolve the latter salt by shaking and add 20 per cent of 95 per cent alcohol. Stir and shake vigorously to assist in the crystallization of the acid potassium tartrat.

Cultivation has changed the character of many fruits, and has much improved their flavor, so that many luscious fruits have been developed from disagreeable, or, to say the least, very medium stock. Cooking improves many fruits by softening the cellulose and converting the gums and allied bodies into a gelatinous form. Sucrose is inverted and pectin bodies converted into soluble forms. If there is starch remaining, this is made more digestible by cooking. There are many fruits that in the raw state are not suitable to use as food for persons with dyspeptic tendencies. They are, however, very satisfactory and useful when suitably cooked. Apples, pears, quinces, and cranberries belong to this class. It should also be noted that a jelly made from the fruit juice is usually more acceptable to an invalid and less irritating in its action than the raw fruit or the jam. This is especially true of raspberries, blackberries, and currants, on account of the numerous fine seeds that are present in the jam.

(*To be continued*)

Experimental Mechanics

By Samuel D. Cohen

(*Continued from page* 536)

Practically all brass fixture parts are threaded in the lathe.

One of the commonest methods of tapping the part, where it is not too large, is to grip it in the large chuck on the *live* spindle of the lathe. The tap may then be held by its square head in a monkey wrench or tap wrench, in such a way that the center hole in the top of the tap rests on the tail center of the lathe. The wrench holding the tap from turning rests against the lathe bed. The belt on the lathe or the gearing is shifted so as to give a slow rotative speed to the lathe chuck supporting the part to be threaded. When the material is thus rotating slowly, the tailstock center is slowly advanced, thus causing the tap to start cutting. A taper or plug tap is invariably used in this case, and where the hole does not pass entirely thru the material a bottoming tap may be employed to cut the threads of full pitch and diameter clear to the bottom of the drill hole. Where much tapping is done in the lathe, it becomes a very simple matter to lubricate the tap by placing a can contain-

(*Continued on page* 595)

Building and Testing Small Transformers

(*Continued from page* 534)

spools and bring the end out, marking it P. Commencing about ⅛" from the end of the spool, wind the small wire on evenly, stopping about ⅛" from the opposite end. Cover the layer with paper and proceed in like manner until you have twelve layers on. Now fasten the wire so that it cannot unwind, remove the spool from the block and insert the core pieces from alternate sides. Do not cut the wire, but scrape a small bit of the insulation off and connect the primary coil to the 110 volt A.C. circuit with a 25-watt Tungsten lamp in series. Leave the secondary coil open. If the lamp lights up brightly, you have not enough wire on the primary. Cover the bare spot on the wire with a small piece of paper or silk and wind on two more layers and test again. Now if the lamp does not glow at all, you have enough wire on, but if it still glows a dull red, wind on another layer. When you have sufficient wire on the coil the lamp should show no color at all. Now short-circuit the outside ends of the secondary coil and if the transformer is working properly the lamp will light up quite brightly. Make the terminal at this end of the coil in the same manner as at the beginning and cover the coil with paper or Empire cloth.

MOUNTING THE TRANSFORMER.

There are several ways of mounting the transformer, but probably the best way is to drill a hole thru each end of the core piece. Do this after the transformer is all assembled. If you place a block of wood under the ends and another over them, clamping the blocks together with screws, you can drill thru the laminations without any trouble. It can now be mounted on a board.

Now as to varying the size and output of a transformer. By keeping the same proportions thruout in making the core pieces, having a difference of eight or ten sizes between the primary and secondary wires and testing as above, you can get almost any voltage you desire. For example, if you wished to make a simple bell-ringing transformer, make the center tongue of the core about ¾" x ⅝" and the other sizes in proportion. Use four layers of No. 26 wire for the secondary and ten or twelve layers of No. 34 wire for the primary. If you wish to make one larger than the one given, make the center tongue 1⅝" x 1⅛", use five layers of No. 16 wire on the secondary and fourteen or sixteen layers of No. 26 wire for the primary.

TWO TRANSFORMERS GIVE GREAT FLEXIBILITY.

A very nice arrangement for the experimenter who desires to have a large range of voltages is to make two transformers like the one given in detail. Make one with no taps off the secondary and the other as described. Mount them on one board and wire up according to the diagram shown in Fig. 7. This will give a range of from 1 to 35 or 40 volts and the system is very flexible. The two primaries are in multiple, and may be used together or separately. The secondaries may be used separately, in series or multiple. The four steps in transformer No. 1 give you four different voltages; in series with No. 2 you get four more; in multiple, four more. Now if you cut in the 25-watt lamp on No. 1 circuit, you will get four still different voltages, and if you replace the tungsten lamp with a 16-candle-power carbon lamp, you will get four lower voltages still, so that you have at your command almost any voltage you wish within the limits of the maximum power of the two transformers.

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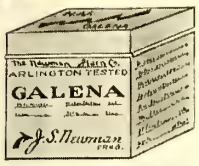

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The receivers are built after the most approved design. The backs are made of aluminum. Each receiver is wound to 1000 ohms (2000 ohms per pair) with electrolytic copper wire of the highest grade. The best magnet steel obtainable is used in the construction of Red Head 'Phones—and plenty of it. The interior parts of each receiver are highly nickled and polished. The diaphragms are extra thin.

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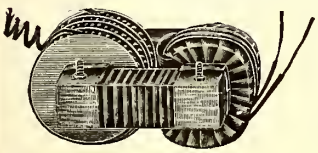

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Our 1/6 K.W. Transformer enables you to enjoy all the advantages of transformer operation at a lower cost than ever before.

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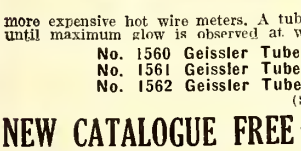

Geissler Tubes are now very scarce and difficult to procure. The large bulk of tubes used in America were of German manufacture and, of course, are now practically extinct in this market. We are one of the very few American concerns who have attempted their manufacture.

The Geissler, or Vacuum Tube, is simply an exhausted glass container, provided with suitable electrodes for passing a high tension current thru the residual gases. The discharge is accompanied by a beautiful colored glow, ranging from greenish blue to orange, pink and red, depending on the degree of vacuum and the structure of the residual gas contents. Many beautiful and interesting experiments may be performed with Geissler Tubes.

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Latest Amateur Radio Receiving Apparatus

(*Continued from page* 542)

with some of the standard type vacuum tubes and having such constants as will give best and most efficient results. A series resistance is inserted in the filament circuits, in such position as to give a negative charge on the grid, thereby eliminating the use of external means of producing this effect necessary in proper amplification work. These resistances are mounted on the vacuum tube holders.

Three jacks are mounted on the lower part of the panel and so connected that with the aid of the jack plug connected to the telephone receiver as shown, it is possible to quickly interchange from the vacuum type receiver circuit to the first or second stage amplifiers as desired simply by inserting this plug in the respective jacks. The jack to the left is used to connect the telephone directly across the vacuum tube detector. The middle jack connects to the first stage amplifier, and the jack to the right connects the second stage amplifier to the telephone. The jacks are so constructed that when the first stage is connected in series the second stage is kept open, thereby eliminating the unnecessary flow of current to the second stage, and when the plug is thrown in the second stage jack the first stage jack is automatically closed, thereby permitting the first and second stage amplifiers to be used simultaneously.

The binding posts to the left are the *input* side to the amplifier and are connected to the telephone side of the vacuum tube receiver. The two lower binding posts to the right are connected to the filament battery, the two center binding posts are connected to the plate battery, while the two upper binding posts to the right are connected directly across the second stage of the amplifier and are used in connection with a loud-talking telephone.

Each vacuum tube has its individual filament rheostat and this is mounted on the outside of the box (as shown in Fig. 3). Two holes, closed by Bakelite covers on top of the box, permit the operator to insert or remove the vacuum tubes from their respective sockets whenever desired.

All of the instruments are of standard height, and each set of binding posts on each respective instrument is so arranged that by means of metallic straps it is possible to connect the receiver, the vacuum tube detector and the amplifier as a complete receiving equipment.

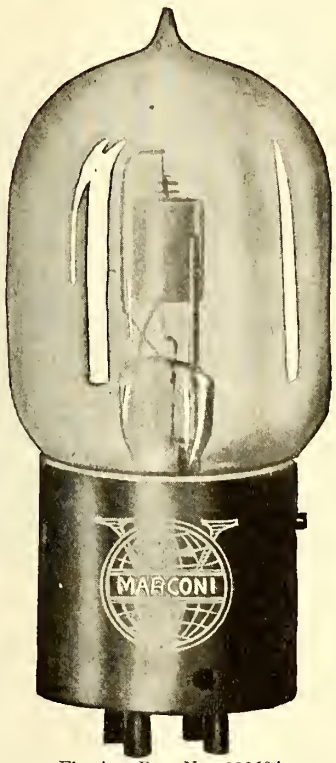
NEW YORK ELECTRICAL SHOW TO BE RESUMED.

The electrical exposition and motor show is to be resumed this year, opening at the Grand Central Palace on September 24th. This will be the first show since 1917, last year's display having been omitted because of the war.

In announcing the resumption, Arthur Williams, President of The Electric Show Company, said that while there had been some uncertainty as to the time and place of the exposition, there had never been any doubt that the first year of peace would see the exposition back in its accustomed place. In fact the show plans began to take form soon after the armistice was signed.

The Grand Central Palace was used during the war as a debarkation hospital. An indication of the importance with which the electrical industry regards this show is seen in the fact that 40 per cent of the space had been assigned to exhibitors before the date of the exposition had been finally settled upon.

THE HEART OF THE WIRELESS



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The approximate operating life of the MARCONI V. T. is 1,500 hours.

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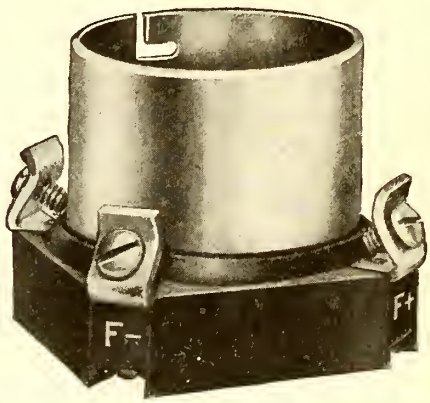

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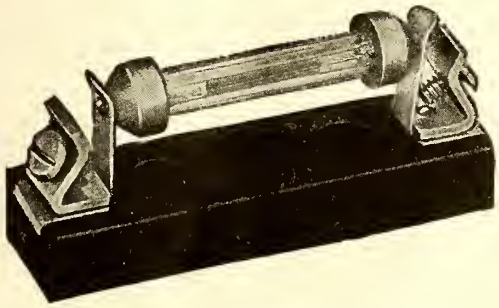

Standard Resistance, Complete $1.00

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Resistances of any special fractional values up to 6 megohms can be supplied.

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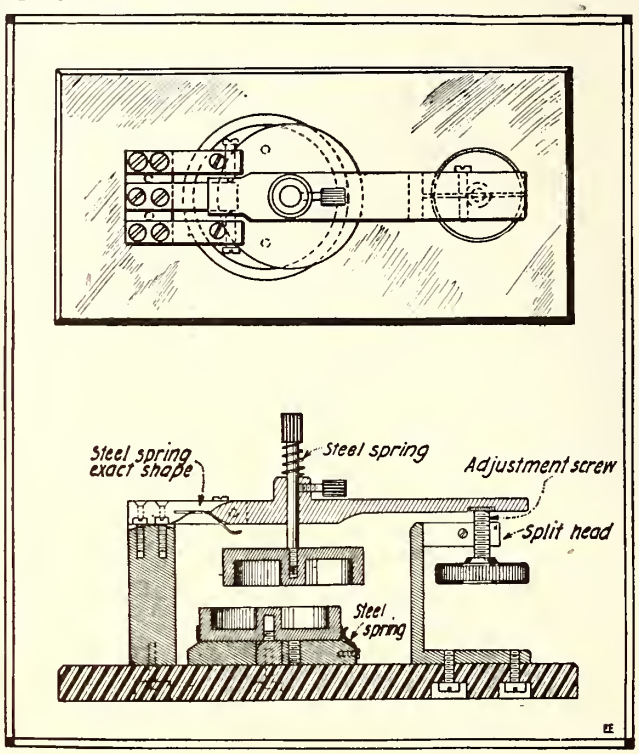
An Efficient Radio Crystal Detector

By Robert F. Gowen

(Continued from page 544)

In conclusion a few remarks regarding the operation of crystal detectors in general may be in order. It is best, of course, to cover over any crystal detector with a glass bell or cup so as to keep it free from dust and the dampness of the atmosphere, which tend to corrode the surface of the metal parts and the crystals, thus impairing the efficiency of the instrument. Another very good thing to watch out for in operating crystal detectors is vibration.



Sectional and Top Views of Crystal Detector.

The Submarine's Under-water Radio

(Continued from page 560)

E. B. Rosa, Acting Director, U. S. Bureau of Standards.

SUBMARINE RADIO.

During the past summer (1918) a series of experiments have been carried out by J. A. Willoughby and P. D. Lowell, of the Bureau of Standards, at the submarine base, New London, Conn., with the view of improving, if possible, the present methods of radio communication with submarines. The experiments have shown that communication at sea can be carried on under all conditions, more efficiently with an insulated closed loop than with an ordinary antenna now in general use. The loop is of simple construction, requires no mast and therefore does not interfere with submergence. Under storm conditions or during a submergence where the ordinary antenna is useless, communication by means of the closed loop is perfectly practicable. The following are among the most important results obtained:

A. When the submarine is submerged, any North American or European station can be received as distinctly as when it is on the surface; the maximum depth of submergence, however, is determined by the wave length of the transmitting station. To receive short wave lengths it is necessary that the top of the loop be near the surface of the water, whereas a wave length of 10,000 meters can be received when the top of the loop is submerged twenty-one feet. Still longer wave lengths can presumably be received at still greater depths.

B. Recognition signals can be exchanged (using the standard 952 meter wave length) at a distance of ten or twelve miles when the submarine is completely submerged, the maximum distance being obtained when the top of the loop is practically at the surface, decreasing to two or three miles when the top of the loop is eight or nine feet below the surface.

C. Submergence of the submarine during reception or transmission of message does not alter the wave length, though if the maximum depth for the wave length in question is exceeded, communication of course is interrupted.

D. When the submarine is running awash or on the surface, signals can be transmitted (with a 1-KW. spark set) a distance of at least a hundred miles even under very stormy conditions; grounds or short circuits caused by heavy seas, which render the ordinary antenna useless in stormy weather, do not affect the closed loop.

E. The closed loop can also be used as a direction finder, either on the surface or submerged, the maximum strength of signal being obtained when the long axis of the loop (of submarine) is pointing toward the transmitting station and the minimum signal when it is at right angles to the stations.

(Continued on page 590)

Government Radio Control—Once More

(*Continued from page* 541)

cient to maintain contact under all circumstances with American military and naval forces abroad. This was done successfully and as one result this department has had a wide experience in transocean radio communication.

No one thing indicates more clearly the closeness of contact that is surely coming in the world than the fact that it is now quite within the practical to erect a radio station so effectively that its signals can be intercepted in every village in the world. Such an instrumentality can be of incalculable value in bringing the world together and furthering common understandings. The same instrumentality, however, gripped by evil-minded government or private enterprise, is just as available for selfish and dissentious purposes. Yet the risk must not be overlooked and such control must be provided as will lead to its use for social and not antisocial purposes. From the very character of radio its development and control must be considered from a world viewpoint. Messages in the air recognize no boundaries. The full utilization of radio requires world organization and coordination.

From an American commercial point of view, it is evident that the permanent extension of American foreign trade is largely conditioned upon cable and radio communication. Orders are placed and ship movements are directed largely by cable and radio. If other countries have better communication services with lower rates, their nationals have a distinct trade advantage. Further, it has become clear that if the American reader is to have full news reports from all parts of the world, and if American news—the publication of which has very definite commercial and political advantages—is to be printed throughout the world, America must have a highly efficient communication contact with all parts of the world.

As high-power radio is going to play an important part in future commercial development, it is incumbent upon the United States to give immediate consideration to this fact. It would be very detrimental to the interests of the United States were the ultimate control of high-power radio to become lodged in a foreign corporation or in any foreign country or if the United States lagged behind in the utilization of radio.

The Navy Department is required, for purposes of communicating with its ships at long distances and with its outlying bases, to maintain and operate high-power radio stations. These stations are a naval necessity for purposes of national defense. In normal times it is inconceivable that all the available time of these stations will be utilized for Government messages. It seems a comon-sense view that the spare time of these stations should be utilized for the benefit of the American people by handling personal, commercial, and press messages.

Whether the Government should own and operate all transocean radio stations is a subject on which the department, on the basis of its experience, has decided views. Especial considerations enter into radio communication between the United States proper and American possessions. Naval operations and assurance of uninterrupted communication with outlying possessions make essential the further development of these facilities and the maintenance of stations and personnel at highest efficiency. Radio communication at low rates will go far toward linking our outlying possessions to this country. Certainly under no circumstances should such radio communication be allowed to pass into the control—direct or indirect—of foreign corporations or countries.

The immediate problems in connection with transocean radio are: (1) To make available to American commerce and press the present Government-owned stations; and (2) to further the development of transocean radio for the benefit of this country.

Since the Government must have a high-power radio system for its control of the fleet and for other Government business, which includes communication with Army transports, Coast Guard vessels, aircraft, lighthouse tenders, lightships, weather reports, storm warnings, time signal service, hydrographic information and safety of life at sea, it is a needless duplication of capital and effort to permit private stations to operate where they might interefere with each other and with the military and other Government work of stations, and where the Government stations can easily handle commercial work in times of peace; one control only can efficiently manage the variety of communications required.

Radio communication should be considered not alone from the point of view of Government ownership of utilities, but chiefly from the point of view of the best interests of the United States in its international relations. The governments of many of the great powers control wireless either directly or indirectly. The Marconi Wireless Telegraph Co., a British organization, has endeavored to establish a British-controlled wireless circuit of the globe. The high-power Marconi stations in the United States and Hawaii form a part of this system. The high-power stations at Sayville and Tuckerton, as well as those in certain parts of South America, were constructed by German corporations.

The Navy Department is the principal user and

the most extensive buyer of radio apparatus in the United States. It has had the strongest influence in developing apparatus since the early days of the use of radiotelegraphy in this country. It has gained large experience concerning the operative features of radio apparatus, and it is convinced that Government operation and control of all transocean and ship-to-shore stations used for commercial purposes, is necessary on account of present interference between stations, and for other reasons given below:

(*a*) To permit the greatest amount of business, Government and commercial, being done through consistent changes in apparatus, through systematic apportionment of any prompt and frequent changes of wave lengths, and through standardized methods of operating, one management is necessary.

(*b*) Radiotelegraphy has been looked upon as a natural Government monopoly. Since only by the closest regulation can the best use of this art be obtained, not only for commercial and safety at sea, but for military purposes, radiotelegraphy is a strict Government monopoly with the larger number of foreign nations; and, in those countries where commercial stations are permitted, the Government control is generally so strong as to amount to monopoly.

It seems therefore admitted that:

(*a*) Efficient radio communication for military (naval) and other Government purposes is a necessity.

(*b*) Efficient radio communication requires effective control; effective control requires a monopoly and the Government should exercise that control.

(*c*) Military (naval) necessity demands not only efficient and rapid communication, including effective control, but protection of the radio stations from destruction.

(*d*) During periods of strained relations, as well as during war, direct Government control and operation would be the only safe and effective control and operation, as the personnel would be subject at all times to Government supervision and discipline.

(*e*) The commercial interests of the Nation will be served best by having its radio communication facilities under a control that is non-partisan, and one which precludes the possibility of foreign domination or of private domestic monopoly, with consequent liability to preferential treatment by such agencies, of the interests controlling them.

(*f*) The dissemination of news to all countries can be accomplished best and mutual international understandings can be arrived at with more facility through national control of radio.

Radio traffic is very much congested at present; but on account of the centralized control by the Navy at the large ports, there is more traffic being handled than ever before. To turn to the old method of separate control by competing private companies would be disastrous to the merchant marine and the general public.

One central control facilities the coordination of the various systems, i. e., coastal, aircraft, medium power and high power. It enables the proper concentration of radio as an aid to navigation and other radio developments designed to render the life of the mariner more safe.

High-power radio is international in character because it causes interference thruout the world. It is much easier for the Government to regulate international interference than it is for private companies to do so. Most of the countries of the world already own all radio stations within their boundaries, and it is more or less a simple matter for the United States Government to come to an agreement with foreign administrations regarding technical details.

Also, as the art advances and new apparatus is constructed, that will lessen the amount of interference, the international conventions will be modified accordingly. A private radio communication company might not be able, on account of financial reasons, to adopt the more modern apparatus. This might result in complications with foreign countries, and further handicapping of the radio service for the general public might ensue.

In certain localities there are several high-power stations within a small area. When they operate independently the business of all is seriously handicapped. But, on the other hand, when they are operating from a central control, business is expedited, and the general public is able to file more messages. In this connection, it might be said that a station running at full load and handling a maximum amount of traffic is able to give cheaper rates to the general public than those stations which are not running at full capacity on account of interference. The only way to handle transocean radio traffic efficiently is to control all the stations from a central point. A few radio stations controlled in this way will handle more traffic than several cables.

In the above I have endeavored to advance proper arguments which would seem to show the desirability of Government ownership of all radiotelegraph stations which are engaged in ship-to-shore work or long-distance transocean work, and particularly that these should be under the jurisdiction of the Navy Department, which Government department alone has the means and facilities to carry on this work efficiently.

This question of national and international communication by means of radiotelegraphy is particularly prominent at this time, when on ratification of the peace treaty, all restrictions on the use of this art will be removed and many interests will be attracted to this form of investment. It is conceived and shown that ship to shore and transocean radiotelegraphy can only be efficiently carried on under a monopolistic control, and this department contends this should be a Government monopoly, and requests congressional authority to assume this ownership and control. At this time this depart-

ment is confronted with conditions which make it imperative to ask for this monopoly.

Obviously the United States can not own radio stations in other countries. These countries fall into certain groups: (1) Those in which the Government itself maintains a radio monopoly; (2) those in which the Government permits its own nationals, but not foreigners, to own and operate stations; (3) those in which any authorized individual or corporation can erect s ations.

Obviously every encouragement should be given American companies to manufacture and sell radio equipment abroad and to own and operate stations abroad. The American Government-owned stations should exchange traffic with such stations and assist them in any legitimate way. Especially should any patents or improvement controlled by the Government be made available to such American companies under proper safeguards and guaranties.

In conclusion this department recommends that Congress immediately enact legislation regarding radio communication along the following lines:

(1) Either by a committee of Congress or by special designated commission, authorize a comprehensive study of the problems in connection with radio within the United States. This, however, is not of immediate concern to this department. Of course, the department stands ready to give the benefits of its experience and technical knowledge.

(2) Authorization to the President to set aside by proclamation certain bands of wave lengths for ship-to-shore work, for shore to aircraft, and for transocean services in accordance with international conventions and demonstrated needs from time to time.

(3) Constituting ship-to-shore radio service a Government monopoly under the Navy.

(4) Constituting transocean and international radio service a Government monopoly under the Navy.

(5) Authorization for Navy Department to utilize immediately all Navy radio stations for commercial and press business.

(6) Authorize the Navy and other departments to assist American enterprise in the sale of radio apparatus and the development of American-owned radio stations abroad, and especially to authorize the Secretary of the Navy to authorize the use by American companies under proper conditions of Government-owned patents and improvements, to be paid for either in exchange of patent rights or in other suitable ways.

Sincerely, yours,

JOSEPHUS DANIELS.

THE SPEAKER OF THE HOUSE OF REPRESENTATIVES.

Radio Problems in Aviation

By Edward Rice Doyle

(*Continued from page* 543)

factors of capacity on an airplane, since he is used to the high building and tower aërials and the solid capacity of Mother Earth. But the airplane must give its capacity effects with little more than the engine and tank metals for counterpoise. And to build up any additional capacity with lengthened aërial means increased weight and lowered flying efficiency. These considerations have therefor held the aviation radio sets to wave lengths of 300 meters or less. And if any radio engineer was asked to design a transmitting set with a minimum range of 500 miles with 300 meters to work with he would think you had asked the impossible.

It is not so difficult to use loading coils to permit of reception by the radio set in an airplane of longer wave lengths than 300 meters, but the added resistance is always undesirable and for transmission it is impracticable.

And in addition to the head resistance and structural limitations on the radio sets for airplanes we have a number of other complications peculiar to aviation radio, to wit:

The engine noises are always present during flight and make accurate message reading difficult even with "noise-proof" receivers. The army practically never attempted to require aviators to receive messages in the air. All signals to the airplane were visual.

The engine magneto sets up a field which has a marked effect in reducing the transmitting range of the airplane set ahead.

Effective power generation for transmitting means a sacrifice of speed. If coupled

to the engine it means a loss of power and if fan-driven generator is used it must greatly increase head resistance. Storage batteries of sufficient capacity are too heavy.

On account of the narrow range of wave lengths available for airplane radio sets, the possibility of interference is greatly increased.

Since a minimum weight in coils and condensers used in the set itself is necessary, broad tuning is generally used, and this means further difficulty from interference.

Changes of altitude which affect condenser capacity are liable to make prearranged wave length communication difficult where close tuning is required.

Cloud effects are apt to reduce the efficiency of transmission and reception, while static can effect airplane radio communication as disastrously as a land station.

The higher the voltage used on the airplane set the higher the fire hazard. Many precautions against sparks which could be observed in a roomy land station are impossible in the small limits of an airplane cockpit.

Difficulties in controlling the frequency of the generator, especially if fan-driven, involve wave length difficulties not encountered on land.

If in spite of these difficulties some radio engineer can evolve a system that will even partly afford effective radio communication with the airplane, he will find ample rewards awaiting him.

Aside from the structural difficulties presented by the airplane toward experimental work, there is always the actual difficulty of "flying" itself. You can plot an audibility chart for a land station with accuracy, but the airplane is constantly moving while in the air and at every moment it is operating under different conditions. To efficiently experiment, the airplane must proceed thru a given maneuver at a given point several times and the possibilities for error are magnified with speed and distance.

The solution of those problems seems to lie in larger planes. With greater wing spans and greater counterpoise capacity the airplane can attain certain advantages. A plane with a double fuselage, for example, ought to give the best structural advantages both in efficient flying (not to be considered here) and in maximum radio control. (See Fig. 3.)

Note that to obtain directional effect in any point of the compass a maximum change of direction of flight required would be but 45 degrees at most. This is certainly not a serious handicap. Also note the absence of trailing wires.

For ideal results, the set would be operated by a storage battery of large capacity, charged by a generator actuated by either of the engines. Thus if the airplane were at rest on the water or land, the set could still be used and any variation of speed or wind would not affect wave length or power input.

Four or five stage amplifications could be used to obtain increased sensitivity of the set to calls, and close tuning would be possible with finely graduated fixt air pressure or oil condensers.

Permanent aërial supports would be built into the airplane by the manufacturer.

DR. GOLDSMITH DIRECTOR OF RESEARCH FOR AMERICAN MARCONI COMPANY.

Dr. Alfred N. Goldsmith, professor in charge of electrical engineering at the College of the City of New York, has been appointed Director of Research of the Marconi Wireless Telegraph Company of America. Dr. Goldsmith is Editor of Publications for the Institute of Radio Engineers, and has recently written an important book on the subject of Radio-telephony.

The Submarine's Under-Water Radio

(Continued from page 584)

The design and specification of the closed loop are given below:

DETAILS OF SUBMARINE LOOP ANTENNAE.

The loop antenna consists of two insulated wires *grounded* at the extreme ends of hull carried over suitable supports to the bridges, and thence thru radio lead-ins to the apparatus.

(1) *Wire.*—Seven strands of No. 14 B. & S. phosphor bronze wire, covered with 40 per cent Para rubber, to a total outside diameter of ½".

(2) *Supports.*—Two substantial masts, triangular or oval in cross-section, 3 feet high with insulators at the top, erected at either end of the boat and braced to withstand considerable strain.

(3) *Stanchions.*—Two stanchions insulated at the top placed high enough to support the wire at least 1 foot above the bridge.

(4) *Radio Insulators.*—An extra radio insulator similar to the one already installed, placed in the space now occupied by the antenna mast (or in any convenient place at least 3 feet away from the other insulator), and extended vertically thru the hull.

(5) *Water-tight Sleeves.*—(To prevent the sea water from working up under insulation on wire.) Brass stock 3" long bored to outside dimensions of insulated wire for 2¾" and drilled dimensions of bare wire for ¼". The wire is stript of insulation for a few inches and is slipt thru the sleeve, the insulated portion being smeared with white lead and the stript portion being soldered to the brass.

(6) *Grounded Connections.*—Lugs on end of wire grounded to hull by bolts.

(7) *Lead-in Joints.*—Junction of insulated wire and radio conductor is made water-tight by marine glue poured in a cylindrical mold.

(8) *Wire-tightening Device.*—(*a*) Turnbuckles may be placed at the end of each wire next to ground connections; or (*b*) in order to take up slack on both wires equally it is preferable if construction of boat permits to place one insulated turnbuckle between stanchions on bridge.

(9) *Receiving Apparatus.*—Tuner capable of receiving wave lengths of 300 to 16,000 meters, and oscillation audion detector and three-stage resistance type amplifier of French design. (The Navy standard audion control box type SE 1,000 two-step amplifier cannot be used unless placed in a noise-proof and inductive-proof compartment.)

(10) *Transmission Apparatus.*—Regular quenched spark set, preferably the 1 KW. size. Terminals of loop antenna are connected to the antenna and ground connections, respectively, with a .0005 microfarad condenser in series with the loop. The ground connection on the set being removed.

SENATOR MARCONI A PEACE DELEGATE.

The new Italian Ministry has selected Senator Marconi as one of the Italian peace delegates. The illustrious scientist was appointed a Senator by the King of Italy in 1915 and seems to be entering more and more into the public life of his country. It is surely most fitting that he, whose genius has so greatly contributed to the preservation of human life and the promotion of international communication, should now receive the signal honor of being made a peacemaker. He is shortly to visit America on the subject of the peace treaty and other matters.

Can Radio Ignite Balloons?

(*Continued from page* 516)

WHAT NIKOLA TESLA SAYS

Probably no other living electrician could be found today who can more authoritatively state just what effect can be produced at a distance by radio currents, than Dr. Nikola Tesla. He has produced and measured the greatest electrical discharges ever developed by man—sparks 70 to 100 feet in length, which manifested their influence 12 miles and more distant. In a special interview with the ELECTRICAL EXPERIMENTER representative, Dr. Tesla said in regard to the present blimp disaster:

"Referring to electrical or radio wave action at a distance, I know from experience that if proper precautions are not taken, fires of all kinds and explosions can be produced by wireless transmitters. In my experiments in Colorado, when the plant was powerfully excited, the lightning arresters for *twelve miles around* were bridged with continuous arcs, much stronger and more persistent than those which ordinarily took place during an electric storm. I have excited loops (coil aerials) and lighted incandescent lamps at a considerable distance from the laboratory without even using more than five or ten per cent of the capacity of the transmitter. When the oscillator was excited to about 4,000,000 volts and an incandescent lamp was held in the hand about *fifty or sixty feet from the laboratory,* the filament was often broken by the vibration set up, giving some idea of the magnitude of the electromotive forces generated in the space. The accompanying illustration shows one of my experiments in which I lighted several lamps at a distance of 100 feet from the laboratory, purely by wireless energy. Such induced currents might easily fire a gas balloon under the proper conditions. When the large transmitter coil, 51 feet in diameter, which I had in the center of the laboratory, was powerfully energized, butterflies were carried around in a circle as in a hurricane and could not get out, no matter how they tried. I was unable to satisfactorily explain the gyrations in the circle, altho I can well understand that the charged coil might, by repulsion, keep them in the center. Perhaps the most remarkable of all the observations was the production of sparks in the sand when one walked at some distance from the building. At night a continuous stream of tiny sparks could be seen between the heels and the earth and between the grains of sand. Another most curious effect was the action on horses, which shows how very sensitive they are to electric shock. When I operated with undamped waves, the oscillator being perfectly silent (no streamers whatever), a horse at a distance of perhaps *one-half a mile,* would become scared and gallop away the instant the switch was thrown on. I suppose the capacity of the body was sufficiently great to derive a rather strong current thru the legs which would frighten the animal. When using damped waves the roar was so strong that it could be plainly heard ten miles away and despite all precautions, such as using cotton in the ears, one would get a singular sensation in the head as if something was bursting, similar to that I observed with Röntgen Rays in 1896 or '97, when I was operating with a powerful apparatus designed for their production.

"In my experiments in New York in the laboratories at 35 South Fifth Avenue and at Houston Street, I have exhibited to thousands of people effects of loops or coil antennae. In one experiment, for instance, I would tune a coil about 30 inches in diameter with which I would collect at

any place in a large hall, *nearly three-quarters of a horsepower,* lighting incandescent lamps, producing long discharges, streamers, etc. One of my exhibits, which was particularly appreciated, was a coil carried on the head which, when resonantly excited, would develop streamers several feet long.

"As regards that deplorable accident to the blimp in Chicago, of course a powerful wireless plant is capable of setting up, at a few hundred feet distance, electro-motive forces of such magnitude that if there is even moderate rise thru resonance, long sparks may result. *In Colorado I drew 1-inch sparks between my body and an iron pipe buried in the ground about 100 feet from the laboratory.* I think it perfectly practicable to produce an explosion by wireless designedly at a considerable distance from a wireless transmitter, and I look upon the accident as very likely having been due to some such cause. By taking proper precautions, however, it is possible to entirely eliminate this danger and I have devoted much thought to the subject, having early recognized the peril to such bags filled with hydrogen. According to my ideas, the accident is not so much chargeable to the plant as to the neglect of proper precautions on the aërial vessel itself. Such a vessel has a considerable span and the guy wires, gondola and other metallic parts constitute a considerable capacity, so that an appreciable amount of energy can be deprived from a wireless plant at a great distance, as it is well shown in the ease with which messages are transmitted to, and received from, aërial vessels.

"Why do the naval and other authorities allow such forms of aircraft to use an explosive gas like *hydrogen?* A short time ago the press was filled with the wondrous stories of how the U. S. Government experts had perfected the manufacture of the new and non-inflammable balloon gas—*helium,* to such an extent that it was very cheap and readily obtainable in quantities. Funny, how these "new" inventions require so long a time to reach the public and those who need them. Helium, extracted from illuminating gas, is not new or wonderful at all. My friend, Sir James Dewar, showed me experiments with it over 20 years ago."

How radio waves, even at distances of several miles, can cause sparks to occur among bales of cotton, baled with wire hoops, etc., is shown in one of the accompanying illustrations. The cotton bale wires have currents induced in them every time a radio message is sent from the ship or in its vicinity. This induced current is practically never strong enough to heat up the wire, but should one of these wires break and form a spark gap, then very often the induced current will cause a spark to jump the gap. That is enough to start a fire. Where wired bales are packed close together in the hold of a steamer, in trains, or warehouses, here also radio waves are liable to cause fairly strong electrical oscillations to be set up by resonance in adjacent loops on the bales, as the diagram shows. Result, a spark occurs, and another fire of "unknown origin" has started.

M. George A. Leroy, a French chemist, in his municipal laboratory at Rouen, France, very ably demonstrated that wireless waves could without doubt cause fires at a distance. His apparatus is shown schematically herewith.

Mr. Leroy's apparatus has been christened by him the "Igniting Resonator." The apparatus he used consists of a glass bulb having four apertures; one at either side and one at the top and bottom, respectively. The substance to be tested with this igniter resonator can be placed in the airtight glass compartment and the two electrodes very accurately adjusted by micrometer screws fitted to them. The transmitter comprises a spark coil giving a 15-to-20-

inch spark, which was connected with a spark gap, glass plate and tin-foil condenser and a loop antenna or spiral comprising a few turns of heavy wire, about 2 feet in diameter. Several yards distant, Mr. Leroy placed his receiving coil or igniting resonator, which included a loop or heavy copper conductor about three feet in diameter. The action on the device was similar to that of the Hertzian resonator, i. e., whenever the spark coil or transmitting helix were excited, allowing a spark to jump the gap, electromagnetic waves were set up in the intervening ether, causing corresponding currents to be induced or set up in the receiving loop. As in the historic experiments of Hertz, this loop will gather sufficient energy from the etheric waves to cause a small spark to jump a gap connected across the terminals of the loop, as the accompanying diagram clearly shows.

Mr. Leroy carried out many different experiments with his apparatus, placing the glass spark chamber of the igniting resonator in a bath of oil or vaseline, which can be heated when desired by incandescent lamps, etc.

One of the most interesting experiments carried out by Mr. Leroy was that with miniature bales of cotton, which were enclosed in jute wrappers and provided with iron wire bands, in the way cotton is usually packed for shipment. "Spontaneous combustions in cotton warehouses and in shipholds loaded with cotton or similar material, are not always what they seem," says Mr. Leroy, in describing his experiments and results with the radio igniter. One of the hoops encircling the bale of raw cotton may break or become loose under the action of shock or from some other cause, and the gap created by the breaking of the wire, forms a miniature Hertzian resonator. When a wireless station situated in the immediate vicinity, or perhaps at some quite distant point, starts in to transmit (and the more powerful the station the more pronounced the effect and danger from fire of course), currents will be induced in the iron wire around the bales or other packages, and sparks may pass between the various metal members. Especially will they be inclined to jump small gaps in the wire which occur in the immediate loop. We may say right here, that to a layman all of this phenomena may seem somewhat far-fetched, and not within the realm of everyday possibilities, but anyone who has experimented with high frequency currents, as generated from even a small size oscillator, will at once be convinced that these effects can and do take place under most unbelievable conditions. Of course, one objection that the average electrical and radio reader will probably think of, is that if the cotton bales, et cetera, are placed in a steel vessel, that this metallic hull will act as a screen, and that the bales will not have any current induced in their wire loops, but while this may be partially so, in some cases it is not always so by any means; especially when the home transmitting station, such as on ship-board, starts in operating. In this case, the steel hull of the boat is charged whenever the transmitting key is depressed.

The secret, if so we may call it, of the production of inflammatory sparks or discharges in metallic bodies such as here described, lies in the phenomena known as "resonance." This means that the nearer the metallic members come in tune with the radio waves, the more pronounced the induction effects produced in any instance. It is of course readily conceivable that a cargo of cotton bales presents many peculiar conditions of resonance, due to the varying capacities and inductances of the various loops. In fact, so obvious and possible is this condition, that a wooden vessel carrying bales of cotton or other material having wire or metal members to hold them, and providing she is fitted with a

wireless station of even a few kilowatts, that the Editors would prefer to stay on land than go to sea on such a ship.

One of the accompanying photographs shows how a great multitude of close oscillatory circuits are provided unwittingly in all-framed or rigid gas airships, and even in the non-rigid gas airships there is usually a sufficient amount of metal present in the gondola, wires and other fittings to form one or more resonant circuits, which may cause a spark at an imperfect joint or other gap. It should be remembered, as laboratory tests have demonstrated beyond cavil, that it is not necessary to have a metal wire coil *in spiral form* in order to have powerful currents induced of sufficient strength to cause a spark to jump from it; a straight metallic wire, bar or even tools, lying within a few yards of a small high frequency coil, will pick up sufficient energy to cause sparks to jump from them, and they will sometimes glow with a vivid brush discharge when viewed in a darkened room.

NATIONAL INSTITUTE OF INVENTORS.

The installation of the officers of the National Institute of Inventors, 118 Fulton Street, New York City, N. Y., was held at the Broadway Central Hotel recently, in the presence of 1,000 guests and members. After a very fine entertainment in which the well-known coloratura-soprano, Miss Edna Blanche Showalter, had rendered selections, and Miss Cecelia Bornstein executed in remarkable fashion her salome dance, the newly elected officers were installed.

Addresses were given by Prof. Chandler, a chemist of international reputation and patent expert; Joseph H. Choate, Jr., who spoke of the founding of the Chemical Foundation, Inc., to which foundation all the German chemical patents had been turned over by former Alien Custodian, Attorney-General Palmer, and an address was made by Thomas Howard, executive chairman of the institute, on the severance and dissociation of the patent office from the Department of the Interior, and the establishing of a Court of Appeals to pass upon patent litigation. He was presented with a medal for faithful services. Refreshments were served and the guests danced until the wee hours of the morning.

The newly elected officers, to serve until 1920, were L. J. Wing, President, pioneer inventor of exhaust fans; Carl Schonert, manufacturer of automobile accessories, of Newark, First Vice-President; Robert C. Lafferty, architect, New York City, Second Vice-President; George Julian Houtain, attorney at law, of 44 Court Street, Brooklyn, Third Vice-President; Milton F. Williams, manufacturer of pulverizers, St. Louis, Mo., Fifth Vice-President; W. H. Kennedy, Recording Secretary; Nathan Langer, Treasurer; Paul Revere Fay, one of the fighting Sixty-ninth, Executive Secretary, and R. Nerenstone, Assistant Executive Secretary.

On the Board of Governors to serve for five years were elected: David Moss, New York City; L. Kenner, New Orleans; Julius Glantz, New York City; Michael Quinane, Paterson, N. J.; J. M. Harding, New York City.

AND WOMAN IS LUCKY TO MAKE ONE MATCH.

One of our newspaper friends—the Oklahoma City *Times*—quotes us as follows: "The ELECTRICAL EXPERIMENTER tells us that a man contains phosphorous enough to make 800,000 matches, and it might be added that a woman does well to make even one."—(Yes, very well, we'll say she does! With shoes at $25.00 a throw, dresses at $100.00 a piece, and food—Ach! Hoover—the needle!! The thought of H. C. L. to-day gives us a fever of 114° in the shade.—ED.)

Experimental Mechanics

By Samuel D. Cohen

(*Continued from page 579*)

ing oil just above the work. A small brass pipe is soldered into the bottom of the can and leads down to a point just above the tap. By fitting a small valve or stopcock to the bottom of the brass pipe the amount of oil fed onto the tap may be regulated to any degree desired. In threading holes in this manner in the lathe, the tap is very easily backed out by reversing the shift lever on the lathe or counter-shaft, so as to reverse the direction of the chuck, when the threaded object will unwind itself from the tap. In performing this reverse operation to remove the tap, the tail-stock should of course be backed away from the tap so that no pressure whatever is on the tap or otherwise the thread may be ruined, due to the tap being jammed into the threads.

Holes often have to be tapt in very inaccessible locations and for such work a machinist usually provides himself with a long tap wrench. In fact a very good stunt for this work is to arrange a standard tap wrench, so as to fit several different lengths of threaded extension rods, and in this way such out-of-the-way holes can readily be threaded. (*To be continued.*)

Diam. Tap	Thds. per In.	Size of Drill	Diam. Tap	Thds. per In.	Size of Drill
3/32"	48	No. 50	19/32"	12	31/64"
3/32"	52	No. 50	19/32"	14	1/2"
3/32"	54	No. 49	5/8"	10	31/64"
3/32"	56	No. 49	5/8"	11	1/2"
3/32"	60	No. 48	5/8"	12	33/64"
7/64"	32	No. 50	21/32"	10	33/64"
7/64"	36	No. 49	21/32"	11	17/32"
7/64"	40	No. 47	21/32"	12	35/64"
7/64"	48	No. 44	11/16"	11	9/16"
7/64"	56	No. 43	11/16"	12	37/64"
1/8"	32	No. 44	23/32"	11	19/32"
1/8"	36	No. 43	23/32"	12	39/64"
1/8"	40	No. 42	3/4"	10	39/64"
1/8"	42	No. 41	3/4"	11	5/8"
1/8"	48	No. 39	3/4"	12	41/64"
9/64"	30	No. 41	25/32"	10	41/64"
9/64"	32	No. 40	25/32"	11	21/32"
9/64"	36	No. 37	25/32"	12	43/64"
9/64"	40	No. 34	13/16"	10	43/64"
5/32"	30	No. 33	27/32"	10	45/64"
5/32"	32	No. 32	7/8"	9	23/32"
5/32"	36	No. 31	7/8"	10	47/64"
5/32"	40	No. 30	29/32"	9	3/4"
11/64"	32	No. 30	15/16"	9	25/32"
11/64"	36	No. 29	31/32"	9	13/16"
11/64"	40	No. 28	1"	8	53/64"
3/16"	24	No. 29	1 1/32"	8	55/64"
3/16"	28	No. 28	1 1/16"	8	57/64"
3/16"	30	No. 27	1 3/32"	8	59/64"
3/16"	32	No. 26	1 1/8"	7	59/64"
3/16"	36	No. 24	1 1/8"	8	61/64"
13/64"	24	No. 26	1 5/32"	7	61/64"
13/64"	28	No. 22	1 5/32"	8	63/64"
13/64"	32	No. 20	1 3/16"	7	63/64"
13/64"	36	No. 18	1 3/16"	8	1 1/64"
7/32"	24	No. 20	1 7/32"	7	1 1/64"
7/32"	28	No. 17	1 7/32"	8	1 3/64"
7/32"	30	No. 16	1 1/4"	7	1 3/64"
7/32"	32	No. 15	1 9/32"	7	1 5/64"
15/64"	24	No. 16	1 5/16"	7	1 7/64"
15/64"	28	No. 12	1 11/32"	7	1 9/64"
15/64"	32	No. 10	1 3/8"	6	1 1/8"
1/4"	18	No. 17	1 13/32"	6	1 5/32"
1/4"	20	No. 14	1 7/16"	6	1 3/16"
1/4"	24	No. 9	1 15/32"	6	1 7/32"
9/32"	16	No. 10	1 1/2"	6	1 1 7/64"
9/32"	18	13/64"	1 17/32"	6	1 1 9/64"
9/32"	20	No. 3	1 9/16"	6	1 21/64"
5/16"	16	No. 1	1 19/32"	6	1 23/64"
5/16"	18	15/64"	1 5/8"	5	1 21/64"
11/32"	16	F	1 5/8"	5 1/2	1 23/64"
11/32"	18	17/64"	1 21/32"	5	1 23/64"
3/8"	14	J	1 21/32"	5 1/2	1 25/64"
3/8"	16	L	1 11/16"	5	1 25/64"
3/8"	18	19/64"	1 11/16"	5 1/2	1 27/64"
13/32"	14	N	1 23/32"	5	1 27/64"
13/32"	16	P	1 23/32"	5 1/2	1 29/64"
13/32"	18	21/64"	1 3/4"	5	1 29/64"
7/16"	14	R	1 25/32"	5	1 31/64"
7/16"	16	S	1 13/16"	5	1 33/64"
15/32"	14	3/8"	1 27/32"	5	1 35/64"
15/32"	16	W	1 7/8"	4 1/2	1 35/64"
1/2"	12	25/64"	1 7/8"	5	1 37/64"
1/2"	13	X	1 29/32"	4 1/2	1 37/64"
1/2"	14	13/32"	1 29/32"	5	1 39/64"
17/32"	12	27/64"	1 15/16"	4 1/2	1 39/64"
17/32"	13	27/64"	1 15/16"	5	1 41/64"
17/32"	14	7/16"	1 31/32"	4 1/2	1 41/64"
9/16"	12	29/64"	1 31/32"	5	1 43/64"
9/16"	14	15/32"	2"	4 1/2	1 43/64"

To Europe in Three Hours

(*Continued from page* 575)

fair, not to be compared with our passenger carrying types of lighter-than-air aircraft, which incorporate the important factor of having a "dead load" (crew, engines, fuel, etc.); this takes a very large proportion of the total lifting effort exerted by the balloon envelope. In the testing balloon the ratio of "dead lift" to the weight of the balloon itself is very much less, and if some of the gas originally put into the bag has to be dissipated by an automatic valve, to keep the balloon from bursting, there will still be sufficient gas left in descending to lower levels to sustain the recording instruments carried, owing to two reasons, viz.: the greater free expansibility of the small, simple balloon of this type, whose diameter may have increased at the higher altitudes to four or five times its normal inflated diameter at sea level; and again due to the low ratio of the "dead weight" to the balloon weight proper.

High Altitude Airplanes

When it comes to operating airplanes at high altitudes several factors confront us. Some of these factors we have already mentioned in the foregoing text—such as increasing the wing-spread and the total exposed area of the wings; improving the thrust of the propellers by lengthening them and possibly increasing their speed; utilizing air-compressors for the pilot's cab and carburetor systems of the engines; using "vacuum bottle" cabs for the crew, etc. Variable pitch propellers are being strongly advocated by altitude fliers nowadays, including Major Schroeder. These would seem to improve the climbing and propelling efficiency.

As Mr. Harry E. Dey has pointed out, the reduction in the weight of the air falls off as we go up in the atmosphere; at say 3½ miles altitude the weight of the air is about one-half that at sea level, and the resistance has reduced to approximately one-half also. The airplane at this level should therefore, as Mr. Dey also believes and states, be accelerated to *double* its sea level velocity, which let us consider as having been 200 miles per hour. Here then the plane should travel at 400 miles an hour. Some one objects, however, that altho this may be quite true, the supporting power of the air has fallen to about one-half. True; it has decreased one-half for the *former* 200-mile-per-hour speed, but this loss has been neutralized by the *increased velocity*, 400 M.P.H., with the result that the net buoyancy is the same as formerly.

Reasoning on this basis of reduced weight and less air resistance at the higher altitudes, it becomes possible to attain some real hair-raising speeds in an airplane. For example, if we consider the weight of the air at eight miles altitude to be but (approximately, to simplify matters) one-fifth of that at sea level, then the speed which an airplane attaining 200 M.P.H. at sea level, would attain at this altitude (about 42,000 feet) figures to the astounding velocity of 1,000 *miles per hour*. According to this method of reasoning, as followed by Mr. Dey, Europe is only a stone's throw away from us, and we can call up Cousin John or Aunt Kate in London and tell them to hustle over for Sunday dinner. They'll be with you in your New York city apartment and raving over your wife's salad, *just three hours later!* 1,000 M.P.H. divided into 3,000 miles=3; simple, ain't it? Gad, tho, this is awful; our wife's folks will *all* be with us every week-end! Get that!!! You know there's such a thing as "too much speed." What?!

And think of inviting your Aunt Kate or Cousin Myra, from London to make the aërial trip over the pond in three hours! Did you think of the catastrophe that might await you?! No? Well, listen Lester: your aunt, and the rest of the family tree hailing from "dear ol' Lunnun" would be eating your "dinner" at *their* "supper time," and the Sunday visitor from London! Can you imagine him arriving on the morning (at New York) aërial boat at 7 o'clock A. M. He left London at 9 o'clock, traveled over in three hours, which makes it 12 o'clock noon by his turnip; wherefore, and hence—Mr. England would have to sit down with you and eat his *breakfast* all over again, and at "dinner time," at that. It's not as bad as it sounds—the sea air would make it possible.

The Story of Rohlfs—New American "Altitude Flier."

Among other things, Roland Rohlfs, the new American altitude record holder, recently stated:

"I shall take every precaution on my next trial. In order to obviate the trouble I had in keeping my motor warm shutters will be provided, and the gasoline pump, which became airbound, making it necessary for me to pump by hand nearly two hours, has been adjusted. I shall also make more careful selection of the gasoline I use. In my last attempt I used a high test gas and I failed to get within 200 revolutions per minute what I got the first time.

"I shall also wear more clothing. My hands got very cold, in spite of the fact that I had on several pairs of gloves and mittens. I shall also try more oxygen, for on both my flights my supply has given out. I always try to be as sparing as possible, not using it until I reach approximately 23,000 feet.

"What is the purpose of altitude flights? I suppose most people think they are made merely to satisfy the vanity of the pilot or the airplane designer—something like the automobile speed race. Not at all. It has a distinct scientific value. It gives invaluable data to the meteorologist and will be of infinite value when the time comes for the establishment of air lanes of travel for airplanes.

"At the present time our knowledge of conditions is based largely on observations made from kites and from balloons, but these are stationary and, for the most part, the information gained is applicable only to localities in which the tests are made. With the airplane one can cruise about in the thin upper strata of the air and actually chart the conditions that can be expected to prevail there. It will enable us to make certain lanes of travel for airplanes of various types, say the upper levels for the speedier planes and the lower levels for the slower going machines.

"We also get valuable information concerning the kind of planes and motors that will have to be built for use at various air levels. It gives us data concerning the way motors act under certain conditions and at certain levels, how the machine maneuvers, what sort of wing construction is necessary.

"It also gives us valuable medical data concerning the effects of different altitudes on different people.

"It is almost impossible for us to conceive that six miles above one of our bathing beaches, six miles above cities where people are sweltering in the heat, the temperature is twenty-five degrees below zero and that a wind of from 100 to 200 miles an hour is blowing. That information in itself will be important when commercial aviation gets to be a regular thing. With all this information at hand, think how easy it will be for us to go up in a specially-

(*Continued on page* 599)

Master Electricity By Actual Practice

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing.* That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

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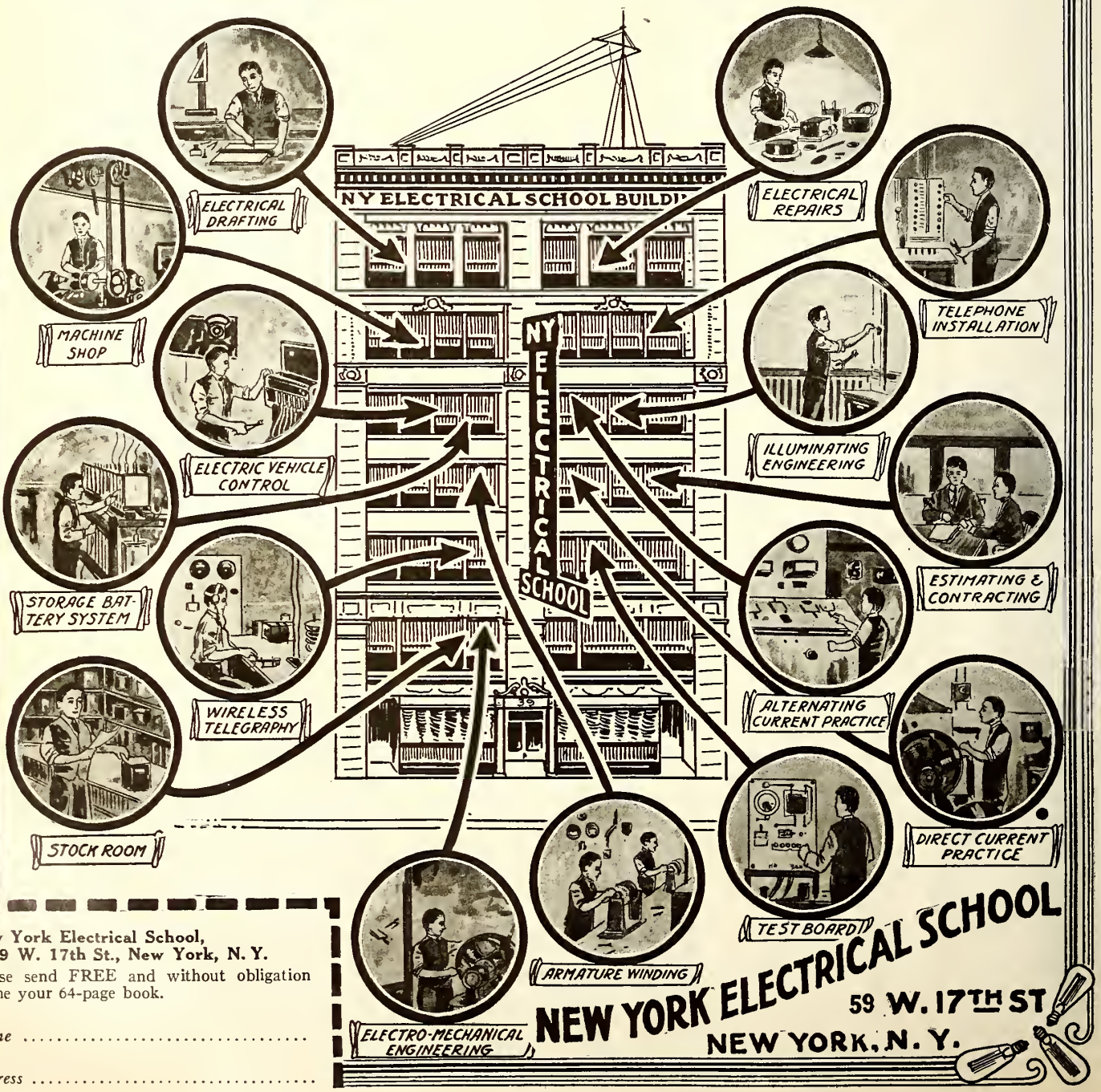

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To Europe in Three Hours

(*Continued from page* 597)

constructed machine, the body built perhaps on the principle of the *vacuum-bottle,* take advantage of the 200-mile-an-hour wind which prevails from the east, *and land in Europe in half a day.* Because, with a wind of that velocity, you can conserve gasoline and simply let the wind blow you where you want to go. You can get the wind-direction at various levels by means of observation kites.

"Speeds greater than we have ever thought of will be attained and commercial aviation will take advantage of them sooner or later."

Rohlfs flew a Curtiss Wasp biplane equipt with a twelve-cylinder 400 horsepower Kirkham motor. The biplane weighed 1,900 pounds and had a wing span of 32 feet and half an inch and measured 23 feet over all in length. He tried out the climbing powers of the machine in an unofficial flight, in which he reported reaching a height of 31,000 feet. Numerous witnesses were called after his official altitude climb, to make the flight official, and the barograph was signed by Major J. T. Roessel, Major H. F. Miller, Lieut. Col. W. L. Moose, Jr., Captain A. F. Simonin, Colonel Archie Miller, Augustus Post, on behalf of the Aero Club of America; John T. Tarbox, Secretary of the Aero Club of America, and the pilot himself.

New Altitude Record with Passenger.

A new world's altitude record of 30,000 feet is said to have been establisht for an airplane with passenger by Lieutenant Weiss, the pilot, and Mechanician Begue, according to a message from Paris dated August 13. The flight, which took fifty-two minutes, was made at Villacoublay, near Paris. The aviators' instruments showed that they experienced a temperature of more than 25 degrees Fahrenheit below zero. The official figures on the ascent will be made public later.

ELECTRICITY STEERS BLIND MAN.

(*Continued from page* 530)

Not only is it possible to set the compass by touch or by sight so as to travel due north, south, east or west, by the four notches in the adjustable lid, but it is also possible to set the compass so as to maintain a course in any given direction. This is accomplisht by setting the compass so that the point on the compass which would point north with the needle when the instrument is in a natural position is pointed in the direction desired. The two contact pins are then dropt over the compass needle by means of the lid or cap.

It is difficult for men traveling in the woods or on the desert to maintain a set direction. But with the direction indicator attached to his belt, the wearer could set the compass before starting out—changing it when he desires—and it would warn him every time he deviated from the determined course.

The instrument can be used on boats to automatically maintain a desired course, and this development is being worked out by its inventor. It would also be practicable for aircraft. Instead of sounding an alarm, the device would result in throwing over a rudder, and the boat or aircraft would at once resume its predetermined direction. Especially valuable would the device be for torpedo or bombing craft that are automatically controlled, says its inventor.

Contributed by L. W. PADRONE.

My Inventions

By Nikola Tesla

(*Continued from page* 556)

this is also true, and perhaps more so, of certain defects in the brain which deprive the automaton, more or less, of that vital quality and cause it to rush into destruction. A very sensitive and observant being, with his highly developed mechanism all intact, and acting with precision in obedience to the changing conditions of the environment, is endowed with a transcending mechanical sense, enabling him to evade perils too subtle to be directly perceived. When he comes in contact with others whose controlling organs are radically faulty, that sense asserts itself and he feels the "cosmic" pain. The truth of this has been borne out in hundreds of instances and I am inviting other students of nature to devote attention to this subject, believing that thru combined and systematic effort results of incalculable value to the world will be attained.

Dr. Tesla's First Automaton.

The idea of constructing an automaton, to bear out my theory, presented itself to me early but I did not begin active work until 1893, when I started my wireless investigations. During the succeeding two or three years a number of automatic mechanisms, to be actuated from a distance, were constructed by me and exhibited to visitors in my laboratory. In 1896, however, I designed a complete machine capable of a multitude of operations, but the consummation of my labors was delayed until late in 1897. This machine was illustrated and described in my article in the Century Magazine of June, 1900, and other periodicals of that time and, when first shown in the beginning of 1898, it created a sensation such as no other invention of mine has ever produced. In November, 1898, a basic patent on the novel art was granted to me, but only after the Examiner-in-Chief had come to New York and witnesst the performance, for what I claimed seemed unbelievable. I remember that when later I called on an official in Washington, with a view of offering the invention to the Government, he burst out in laughter upon my telling him what I had accomplished. Nobody thought then that there was the faintest prospect of perfecting such a device. It is unfortunate that in this patent, following the advice of my attorneys, I indicated the control as being effected thru the medium of a single circuit and a well-known form of detector, for the reason that I had not yet secured protection on my methods and apparatus for individualization. As a matter of fact, my boats were controlled thru the joint action of several circuits and interference of every kind was excluded. Most generally I employed receiving circuits in the form of loops, including condensers, because the discharges of my high-tension transmitter ionized the air in the hall so that even a very small aerial would draw electricity from the surrounding atmosphere for hours. Just to give an idea, I found, for instance, that a bulb 12" in diameter, highly exhausted, and with one single terminal to which a short wire was attached, would deliver well on to one thousand successive flashes before all charge of the air in the laboratory was neutralized. The loop form of receiver was not sensitive to such a disturbance and it is curious to note that it is becoming popular at this late date. In reality it collects much less energy than the aerials or a long grounded wire, but it so happens that it does away with a number of defects inherent to the present wireless devices. In demonstrating my invention before audiences, the visitors were requested to ask any questions, however involved, and the automaton

would answer them by signs. This was considered magic at that time but was extremely simple, for it was myself who gave the replies by means of the device.

At the same period another larger tetautomatic boat was constructed, a photograph of which is shown in this number of the ELECTRICAL EXPERIMENTER. It was controlled by loops, having several turns placed in the hull, which was made entirely water-tight and capable of submergence. The apparatus was similar to that used in the first with the exception of certain special features I introduced as, for example, incandescent lamps which afforded a visible evidence of the proper functioning of the machine.

Telautomatics of the Future.

These automata, controlled within the range of vision of the operator, were, however, the first and rather crude steps in the evolution of the Art of Telautomatics as I had conceived it. The next logical improvement was its application to automatic mechanisms beyond the limits of vision and at great distance from the center of control, and I have ever since advocated their employment as instruments of warfare in preference to guns. The importance of this now seems to be recognized, if I am to judge from casual announcements thru the press of achievements which are said to be extraordinary but contain no merit of novelty, whatever. In an imperfect manner it is practicable, with the existing wireless plants, to launch an aeroplane, have it follow a certain approximate course, and perform some operation at a distance of many hundreds of miles. A machine of this kind can also be mechanically controlled in several ways and I have no doubt that it may prove of some usefulness in war. But there are, to my best knowledge, no instrumentalities in existence today with which such an object could be accomplished in a precise manner. I have devoted years of study to this matter and have evolved means, making such and greater wonders easily realizable. As stated on a previous occasion, when I was a student at college I conceived a flying machine quite unlike the present ones. The underlying principle was sound but could not be carried into practice for want of a prime-mover of sufficiently great activity. In recent years I have successfully solved this problem and am now planning aerial machines devoid of sustaining planes, ailerons, propellers and other external attachments, which will be capable of immense speeds and are very likely to furnish powerful arguments for peace in the near future. Such a machine, sustained and propelled entirely by reaction, is shown on one of the pages and is supposed to be controlled either mechanically or by wireless energy. By installing proper plants it will be practicable to project a missile of this kind into the air and drop it almost on the very spot designated, which may be thousands of miles away. But we are not going to stop at this. Telautomata will be ultimately produced, capable of acting as if possessed of their own intelligence, and their advent will create a revolution. As early as 1898 I proposed to representatives of a large manufacturing concern the construction and public exhibition of an automobile carriage which, left to itself, would perform a great variety of operations involving something akin to judgment. But my proposal was deemed chimerical at that time and nothing came from it.

At present many of the ablest minds are trying to devise expedients for preventing a repetition of the awful conflict which is only theoretically ended and the duration and main issues of which I have correctly predicted in an article printed in the *Sun* of December 20, 1914. The proposed League is not a remedy but, on the con-

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My Inventions

By Nikola Tesla

(*Continued from page* 601)

trary, in the opinion of a number of competent men, may bring about results just the opposite. It is particularly regrettable that a punitive policy was adopted in framing the terms of peace, because a few years hence it will be possible for nations to fight without armies, ships or guns, by weapons far more terrible, to the destructive action and range of which there is virtually no limit. Any city, at a distance, whatsoever, from the enemy, can be destroyed by him and no power on earth can stop him from doing so. If we want to avert an impending calamity and a state of things which may transform this globe into an inferno, we should push the development of flying machines and wireless transmission of energy without an instant's delay and with all the power and resources of the nation.

What the X-Rays Show

(*Continued from page* 510)

hardly ever be suspected as being caused by the small and apparently infinitesimal "toothache." The modern dentist not only needs an X-ray, but he practically *must* have one of these scientific apparatus in order to be sure that every tooth is sound.

In figure 10 is shown one of the latest advances in X-rays—the "Movie X-ray." This branch of X-ray science has only been developed to a very slight extent, and gives promise of really wonderful possibilities in the near future. A year or so ago there was exhibited before a body of surgeons and physicians in New York City an *X-ray motion picture* in which the action of various organs, functioning in a live person, were shown, a bismuth meal having first been ingested; the intestines were shown functioning as well as the heart. It is not commonly known that with the modern X-ray, provided with an up-to-date tube of the Coolidge tube, and excited by a 5 to 10 kilowatt, 100,000-volt transformer, and the other necessary appurtenances, practically every part of the body and its organs may be seen on the fluoroscope, or otherwise on the photographic negative or skiagraph. This includes the heart, lungs, stomach, ulcers of the stomach, the intestines, the appendix, gall stones, the gall bladder, and many other ailments and organs within the body which sometimes have to be diagnosed and operated on in a very short length of time, or otherwise the death of the person would often result. *X-ray-therapy* is a new field being investigated today, and gives much promise in the treatment of cancer and various skin diseases.

X-raying tobacco in order to kill organisms, especially the *tobacco weevil,* has been carried on for several years in a number of large tobacco establishments. In this case, the tobacco in large bales is wheeled into an X-ray examination chamber on small trucks, see figure 12. In this manner the tobacco can be very rapidly X-rayed. The powerful rays from the bulb have the effect of killing the weevil even in its primary germinating state.

There are many other industrial uses of the X-ray which space does not allow us to mention here, but among which we may mention the X-raying of steel and copper ingots to analyze the structure and to detect flaws, such as cracks and air-pockets, and of coal for the purpose of extending our knowledge of geology.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section seven cents a word for each insertion. No advertisement for less than 50c accepted. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

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Tires—Direct to you prices. Exclusive representatives wanted each locality to use and sell Mellinger Extra Ply Tires. Guarantee Bond 8,000 Miles. Sample sections furnished. Mellinger Tire Company, 980 Oak, Kansas City, Mo.

Double Mileage Assured. Use self-cured blowout patches. They weld permanently to shoe, are extra strong, easily applied. The outcome of years' practice. Ben's Big Tire Shop, Dept. C, 378-382 Queen's Boulevard, Winfield, L. I.

Lock Your Car Against Theft. Price 25c. R. Wallner, Frontenac, Kan.

Equip Your Car with Air Brakes. Upon receipt of $2.00 I will send you blueprints and full description of my Patented Air Brake. R. E. Welch, 247 Auzerais Ave., San Jose, Calif.

Power Increased, Carbon Eliminated. Results guaranteed; write for booklet. No-Leak-O Piston Ring Co., Baltimore, Md.

Battery Charging Pays Big Profits. City current or gas engine operates. Easy terms. Hobart Brothers, Troy, Ohio.

Fords run 34 miles per gallon with our 1919 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all motors. Runs slow high gear. Attach yourself. Big profits for agents. Money back guarantee, 30 days' trial. Air-Friction Carburetor Co., 270 Madison St., Dayton, O.

Auto Motors and Supplies. Buick, Hupp, Franklin, Michigan, Everett, Hudson, Chalmers. Both water and air cooled motors, $40 each and up. Bosch Magnetos, $15 each and up. Presto Tanks, $5. Coils, Carburetors, Head Lamps, Horns, Air Compressors, Generators, Starters. Write for bargain bulletin second-hand auto accessories. Johnston, West End, Pittsburgh, Pa.

Agents Wanted.

Agents. Big returns, fast office sellers; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Wonderful Chance. Men's Shirts and Furnishings at wholesale rates or make $10 daily as agent starting real business. Goodell Co., 101 Duratex Bldg., New York.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Ave. D, Decatur, Ill.

Agents Wanted—To sell Tubes, Tires and other automobile accessories. DePalma & Main Co., 1105 Fourth St., Braddock, Pa.

Walk Agents—Men with spare time and specialty venders make $5 per day upward canvassing office buildings, banks and business offices selling the famous Calumet Piecepipe (three pieces), genuine French Briar. Put up in attractive individual package. Its sensible construction makes cleaning easy and appeals to everybody. Send for proposition. 10,000 Bankers Have Bought and Recommended It. The Calumet Co., Dept. Q, Mail Sales Division, Cincinnati, Ohio.

Agents—Here's the best line of food flavors, perfumes, soaps, toilet preparations, etc., ever offered. No capital needed. Complete outfits furnished free to workers. Write today for full particulars. American Products Co., 1499 American Bldg., Cincinnati, Ohio.

Insyde Tyres, inner armor for automobile tires, double mileage and prevent punctures and blowout. Quickly applied. Costs little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, O.

$100 Reward if you pick our Keyless Door Lock. New invention. Put on in ten seconds without nails or screws. A handsome brass lock guaranteed at low price of 15c each, coin. Agents wanted. Lock Company, 1551 West Washington, Springfield, Ohio.

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Beginners. Complete "Mail Order System." C, Box 1005, Atlantic City.

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500 Agents Wanted at Once to take orders and sell Mitchell's Magic Marvel Washing Compound; 300% profit; enormous repeater. Own your own business. Astounds and delights every woman who uses it. Nothing like it on the market. Splendid proposition for general agents. We grant exclusive territory and absolutely protect our agents. No license required. Free samples furnished to boost sales. We positively guarantee the sale of every package. Our compound is nature's mightiest cleanser. Contains no lye, lime, acid or wax. Wonderful sales plan furnished free. You cannot fail to make big money. Hurry, hustle, grab this chance. Send for free sample and proof. Better still, send $1 for 10 full sized packages and samples sent by prepaid parcel post. You will make 100% profit on this small order. Territory going fast. Get busy at once. L. Mitchell & Co., Desk 318, 1312-1314 E. 61st, Chicago.

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Salesmen—New proposition that nets $100 to $200 weekly. Give moving picture shows at schools, colleges, universities, chuches, Y. M. C. A's, clubs, lodges, societies and homes. We furnish complete outfit. Write for particulars. W. H. Wade, Dept. 5, 14 N. Michigan Ave., Chicago.

Money-Making Farms. 19 States. $10 to $100 acre. Stock, tools, crops, often included to settle quickly. Write for big illustrated catalog. E. A. Strout Farm Agency, 150 E C Nassau St., New York.

Enter a New Business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

$30 a Week. Evenings I made it with a small Mail Order Business; continued my regular job daytime. Free Booklet Tells How, 2c postage. Albert W. Scott, Cohocs, N. Y.

Substantial manufacturing corporation wants capable men to establish branch and manage salesmen; $300 to $1,500 necessary. You handle own money. Will allow expenses to Baltimore if you will qualify. For particulars address Secretary, 416 N. Howard St., Baltimore, Md.

Build Up an Income in Oil. Others are doing it—Why not you? Today is the opportunity. Join our easy monthly payment plan now—it may mean hundreds in profits. Write for information. National Oil Drilling Co., Dept. K, Houston, Texas.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

5 Big Money-making Schemes. $13.50 less than original price. Postpaid, 50c. Edgar James, 315 Douglass, Indianapolis, Ind.

Advertise. 24 words in 100 magazines, $1. Lists free. Stanford Company, Pittsburgh.

Just one Moment, please! Are you artistically inclined? Would you like to be one of the many well-paid Showcard Writers or Designers? Turn your idle moments into dollars. We will teach you THOROUGHLY, Showcard Writing, Lettering, and Designing by our special method of personal correspondence. Why not make $35 to $75 a week if you have talent? Write for FREE DETAILS NOW! Commercial School of Lettering, Wausau, Wisconsin.

Wanted—A man to organize branch office, engage salesmen, etc., for our indelible ink, which takes the place of check protector. This is a big money-making proposition to the right man. Must invest at least $100 for goods, etc. Attorney's Ink Co., 53 West 125th St., New York City.

Victory. Mechanical Toy Soldier window attraction. 30 inches high. Salutes, turns head, points with finger, etc., as set. Well made, nicely dressed officers, privates, Uncle Sam, etc. Electrically operated. Does some stunt every half minute or oftener as set and will salute soldier and pay no attention to other if desired. Representative wanted in each city and town. Write for prices. The John M. Biggs Co., Box 324, Chattanooga, Tenn.

"Quick-Action Advertising—How It Is Building Business for the Progressive Advertisers of America"; A little story of results told by the advertisers themselves—not the publishers. You will be interested in reading this little booklet which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield Coutlee, 225 W. 39th St., New York.

Exchange Ads.

For Sale—$120.00 I. C. S. Electrical Engineering Course (Complete), $42.00. $60.00 I. C. S. Interior Wiring Course, $25.00. $120.00 I. C. S. Analytical Chemistry Course, $42.00. Many others. Send for list. Courses bought. W. J. Benson, 3722 "M" Str., Philadelphia, Pa.

For Sale cheap, anything electrical you want. Perry Leaphart, Jr., Pendleton St., Columbia, S. C.

For Sale—Three International Chicken Hovers. Used little. J. R. Simpson, Piermont, N. H.

For Sale—X-Ray tubes, high frequency and other apparatus. Write for list and description. Roy Black, Jefferson St., Madison, Ind.

For Sale—Camera and outfit, $15. Hawkins Guides (new), $7. Exide Battery, $10; Vesta Battery, $7. B Flat Cornet, $15. Weston Ammeter, $3. 250 W stepdown transformer, $10. C. W. 6V. 8A motor, $5. Write for description. Wm. Rudolphsen, 1807 S. Turner Ave., Chicago, Ill

Sell. 2½ Horse motor. Polished insulation marble, $.50 ft. Clarence Kositzky, 1602 Poplar, Lincoln, Nebraska.

For Sale—$25 Lionel Electric Train, $15; $3.00 steam engine, $1.50; New Murdock 43 plate variables, $4.00; Holtzer Cabot 3000 ohm lightweight receivers, while they last, $11.75. Big list free. King, Box 42, Mattoon, Ill.

1 Brand-new Lyon & Healy B flat, high pitch, Alto Saxophone, Silver plated sand blasted finish, gold plated bell, pearl buttons; beautifully engraved, leather carrying case with full outfit; cost $165.00; sells to first buyer for $120.00. 1 brand-new L. C. Smith visible typewriter, cost $115.00, sells $75.00. 1 set Eisner drafting and drawing instruments, 15 pieces with solid ivory handles, heavily nickel plated, in fine velvet case, never used; cost $34.00, sells for $15.00. Set new Ford coils, very good condition, $8.00. One Ford master vibrator, cost $12.00, sells $5.00. 1 U. S. Training Rifle, new, exact duplication of U. S. Army Springfield, $5.00. All these articles are wonderful bargains and will be shipped C. O. D. at price stated, with 20% down with order. H. O. Holm, Ryder, N. D.

For Sale—Mignon RW3, seal unbroken, $75. Mignon RJ1 Transmitting cabinet, new, $60. Electro Oscillation Transformer, $4. Duck Navy Type Receiving Transformer, $12.50. Burrows Rogers, Cainsville, Missouri.

For Sale—New Omnigraph and small Radio Receiving Outfit. Milton Jacobs, 428 Fourth Ave., City.

For Sale—Complete $150 ½ K.W. sending, 3,500 meter, bulb receiving set for $80. Write for separately listed prices. Stuart Nivling, 130 Aberdeen St., Rochester, N. Y.

For Sale—Set of Chemicals and Apparatus. Stamp brings particulars. Box 163, Beverly, N. J.

Bargain—Receiving set of phones, loose-coupler, detector, condenser, buzzer, $15. Set of Hawkins Electrical Guides, $7. Or will sell together for $20. M. W. Green, R No. 4 Dowagiac, Mich.

Sell—RLC5 Mignon Cabinet, $30. Audion, $10. Crystaloi Detector, $2.50. Brandes Superiors, new, $5.00. Audio Tron Bulb, $4.00. Money order acknowledged. E. Schuessler, 2209 Wheeler St., Cincinnati, O.

Sell—Large Supply electrical, wireless goods, cheap. Stamp for list. Walts, 2842 Market St., Louisville, Ky.

Swap! Buy! Sell! Free Advertising 3 months. Dime. Trade Topics, Detroit, Mich.

For Sale—Transmitting and receiving apparatus. Everything necessary to build a set. Includes brass, copper, fibre, screws, bolts, rods, binding posts, wire and complete apparatus. Very cheap. Write for list. Edw. C. Schureh, Deer Lodge, Mont.

For Sale—Wireless Mast—84 ft. sectional, built of northern fir, A-1 condition, with weather-proof guys, $30.00. F.O.B. Seneca Falls, N. Y., Loose Coupler, $8.00; New Audion Cabinet, Hard rubber front, New B bats less bulb, but including galena detector, $12.00. W. H. Stevens, The Edgeton, Philadelphia, Pa.

Sell—Cyclopedia Applied Electricity, $12.00; Steven's "Favorite" .22 rifle, $4.00 Electro Chemical Laboratory, $2.00. Schreyer, 72 Ridgewood Place, Staten Island.

Sell—Twin Motorcycle engine, $20; $65 aviation Course, $15. Wilson Ross, Laurelville, Ohio.

For Sale, less than half price, rebuilt chemical and electrical apparatus, also materials. Send 5 cents for list. A. L. Pouleur, Norton, Mass.

Gilbert Wireless. Skinderviken button. Bike-lamp. Telegraph. Printing press. Self-filler pen. Pool, Broadmoor, Colorado Springs.

Sale or Trade—Wireless outfit; Violin; Pyrometer; Foot Switch. Joe Richter, West Allis, Wisconsin.

For Sale. Blue prints for connecting A.C. motors. See ad under "Blueprints." Charles Chittenden.

Sell—Telescope. New. Cost $25. Highest offer takes. Huston Murdock, 734 Grant St., Johnstown, Pa.

Exchange Ads. (Cont'd.)

For Sale—Brand-new E. I. voltmeter, $2.00; jeweler's lathe, foot pedal wheel, $2.00. Geo. Koresh, 219 50th Ave., West Allis, Wisconsin.

Exchange, Buy, Sell. Wireless, electrical goods, etc. Large list 6c. State what you have and want. Zehrbach, Box 250, Hiram, O.

For Exchange—Want Smith motor wheel, good condition, for set of History of Civil War—beautiful books, splendid pictures, cost $30.00, or what have you—motors, etc. B. W. Earl, Edgewater Park, N. J.

For Sale—Complete set 160 ohm phones, $3.25. Shirley Hurlbut, Ilion, New York.

Exchange. Pair New telephones—cost $20.00. Want small gasoline motor. What have you? B. Earl, Edgewater Park, N. J.

For Sale or Exchange. Have fine little cycle car. Reversing gear and new body, 40 tread. Everything practically new. Am building larger car—want Smith motor wheels—Smith Flyer, or what have you? B. W. Earl, Edgewater Park, New Jersey, Burlington County.

Sell—Splendid Smith Premier typewriter, $25; Exchange—Good .22 Stevens rifle for 43 plate variable. Wilkes Dearing, Covington, Tenn, R. 2.

Must Sell. Send stamp for list of electrical goods. Earl Cook, Bernardston, Mass.

Exchange—3,000 meter wireless receiving outfit. Richard Christy, Ferris, Ill.

Aerial Wire—7 strands number 22, pure copper. Highest conductivity and strength. Supply limited at this price. 1c per foot—$9.00 per thousand. L. A. Bates, 8 Moen St., Worcester, Mass.

Exchange—Tesla Coil for Rotary Variable Condenser, or what have you, Wireless or Electrical? John Burke, Geldard St., Valley Falls, R. I.

Miscellaneous.

Wanted. Small gasoline and steam engines, small lathes, drill presses and other light machinery. Will pay high cash prices for good material. Johnston, West End, Pittsburgh, Pa.

Send Stamp for catalog. Chicago Aero Works, 328 River St.

Key Ring Tags, 20c; silver name plates for umbrellas, canes, etc., 20c; skeleton keys, 10c. Send coin. Albert Feth, Dayton, Ohio. (124 Lincoln St.)

"How to Read Thoughts"—Mind Reading at any distance, 20c; "How to Hypnotize"—Cure Diseases, Give Astounding Exhibitions, $1.00; "Silent Friend"—Key to Rapid and Honest Wealth, $1.00; "How to Win," 362 pages—success assured, $2.00; "Health Culture"—Insures Vital Strength, 25c; 5 dozen Money Makers, 30c. Catalogue gratis. Science Institute, E1336 Morse Ave., Chicago, Ill.

"Uncle Sam to the Front," brilliant March, Piano, 10c; "Town Talk," latest Rag Hit, Piano, 15c. Catalogue free. Quincke, Box 48, Station C, Los Angeles, Cal.

Shoes for All the Family, reasonable prices. Educational, business books, etc., Send for descriptive circulars. Retail only. Central Sales Co., 509 Ninth Ave., New York.

Song Poems.

Song-writers' Manual and Guide Sent Free! Contains valuable instructions and advice. Submit song-poems for examination. We will furnish music, copyright and facilitate publication or sale. Knickerbocker Studios, 319 Gaiety Bldg., New York.

Write the Words for a Song. We write music and guarantee publisher's acceptance. Submit poems on war, love or any subject. Chester Music Co., 920 So. Michigan Ave., Room 265, Chicago, Ill.

Write the Words for a Song. We revise poems, write music and guarantee to secure publication. Submit poems on any subject. Broadway Studios, 197C Fitzgerald Bldg., New York.

Song-writers. You can't afford to miss our proposition. Reference, any bank or first-class sheet music house. Warner C. Williams & Co., Dept. L, Indianapolis, Indiana.

Song-writers. Market your compositions. Our successful plan brings results. Work examined free and honest advice given. Morrison Music Shop, Dept. E, Indianapolis, Indiana.

Wanted to Buy.

Cash for Old False Teeth—We pay up to $35.00 per set (broken or not). Also buy discarded gold jewelry, gold crowns, bridges, platinum, diamonds, watches and silver. Send now. Cash by return mail. Package held 5 to 10 days for sender's approval of our offer. U. S. Smelting Works, Dept. 73, Chicago, Ill.

Continued on Page 606

Wireless.

Wireless Bargain Sale. Here is your opportunity to buy first-class Clapp-Eastham wireless apparatus at prices that you will never be able to buy again. These instruments were owned by a commercial company which is now out of business, after being in operation for only six months. Following articles are absolutely brand-new, never used: 3 K.W. Clapp-Eastham condenser in polished case, $40; cost $110. 2 K.W. Clapp-Eastham condenser in polished case, $25; cost $55. Two 3 K.W. Clapp-Eastham spark gaps in polished cases, $15 each; cost $60 each. 3 K.W. Clapp-Eastham "Boston" Key, $3.85; cost $9.00. Two hundred "Electrose" Ball insulators, 15c each; cost 30c each. One hundred "Electrose" ten-inch insulators, 30c each; cost 60c each. No order accepted for less than one dozen either size insulators. Six extra large "Electrose" ball insulators, 30c each. Clapp-Eastham glass plate condenser sections, each 85c; cost each, $3.50. No order accepted for less than three sections. Following articles slightly used, but are in just as good condition as the new instruments described above: 5 K.W. Clapp-Eastham oscillation transformer, edge-wise wound heavy copper strip on heavy rubber pillars, $10.00. 3 K.W. Clapp-Eastham oscillation transformer, wound with one inch wide copper ribbon, coils mounted on heavy rubber sheets, $4.00. 3 K.W. Clapp-Eastham Type "E" transformer in polished case with variation switch on end, $60.00; cost $150.00. 2 K.W. Clapp-Eastham condenser in polished case, $20.00; cost $55.00. Three early type Clapp-Eastham receiving sets in polished cabinets with loose coupler of variometer type; each set has two large variable condensers; set with genuine Periken detector, $20.00; set with Silicon detector, $15.00; set with part of mineral detector, $13.50. These sets cost more than $100.00 each when first placed on sale by Clapp-Eastham Co. 10 K.W. early type Clark wireless transformer sealed in oak case. Hardly used. A gigantic bargain at the very low price of $90.00. 30 ampere "Roller" hot wire meter, $6.00. 3 K.W. 1,800 RPM Eck Rotary Converter, 4-pole, takes 115 volts D C., gives 60 cycles, 75 volts, single phase, 40 amperes, A. C. Absolutely like new. With starting box, $75. Cost over $200. Brandes Navy Type 3,000 ohm receivers, $4.50. Brandes 2,800 ohm receivers, $3.50. Western Electric 2,000 ohm receivers, $2.75. All above F.O.B. San Antonio. No trades considered. Personal checks not accepted. Remit by money order. Considering the extraordinary cheap prices on this fine wireless apparatus, these great bargains will not last long, so send in your order today. Sydney Friedrich, 350 East Commerce Street, San Antonio, Texas.

Amateurs! Special seamless cardboard tubing 5" x 5¼" diameter, 25c per foot. One pound, postage extra. Send stamp for price list. Maier & Co., 335 East 93rd St., N. Y.

Panel Wireless Sets and Parts. Heavy rubber knobs 2¼", 26c; 1¼", 16c. Polished Formica Panels, ⅛ x 8 x 12", $1.10. Post extra. Klaus, Eureka, Ill.

Radio Apparatus of Quality manufactured to your own specifications. Radio Engineering Company, Baltimore, Md.

Transcontinental wireless receiving outfit, $20.00; 7x7x7 Wall Tent, $6.00, and No. 7 American Builder, $7.00. All three in excellent condition. Reason for selling is want of use. Adam S. Hahn, Jr., Hamburg, Pa.

Switch Points. Binding posts, switch levers, and small parts, send 2c. for catalogue describing these and other goods. A. W. Bowman & Co., 23 Church St. (Harvard Square), Cambridge, Mass.

Stamps & Coins.

California gold, quarter size, 27c. Half Dollar size, 53c. Columbian nickel and catalog, 10c. Norman Shültz, King City, Mo.

Free Set State Rev. Approvals, 50% discount. Browne, 111 Willow St., Wallaston, Mass.

Stamps—61 All Different Free. Postage, 3c. Mention paper. Quaker Stamp Co., Toledo, O.

61 different foreign stamps from Russia, Brazil, India, etc., free to applicants for our fine approvals. Send 2c postage. E. W. Spafford & Co., Martville, N. Y.

300 different stamps, 50c. Fred Onken, 630 79th St., Brooklyn, New York.

Free. 25 different stamps and lists, 2c postage. 100 different stamps, 10c. Nutley Stamp Ex., Nutley, N. J.

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South America. Buy direct. 1,000 fine assorted Paraguay, Uruguay, etc., for $2 bill. Exchange rare stamps with collectors and dealers. Lots or on sheets. C. P. Mego, Necochea 193, Lomas Dezamora, Argentine Republic.

Special Variety packets, 15c each; three for 40c. 50 Orientals, 40 Japanese, 30 South and Central American. Lionel Smith Stamp Co., Box 407 Hartford, Conn.

Best One Cent Approvals in America. F. P. Hand, 1117 So. 60th St., Philadelphia, Pa.

Stamps. Send 15c for 30 stamps, all different. Including war issues. W. Baumann, 1033 Levick St., Philadelphia, Pa.

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Boys—Here is the simplest and cheapest electric telegraph ever devised. With the "K" Applicator you need no batteries. Get electricity free, instantly, anywhere, at any time. Send 30c (postal money order) for full instructions how to make the "K" applicator and how to operate an electric telegraph without batteries. Is easier to make and requires less material than you would use in making a kite. Gives constant, smooth, even current day and night, never runs down, even upon closed circuit. Works on any metallic line, even barbed wire fence, as no insulators necessary. The "K" Applicator, Missouri Valley, Iowa.

Radio Paint Glows at night. Bottle, 20c. Box 3613 Kens. Station, Philadelphia.

Storage Batteries. Make the plates yourself, we will tell you how. Sample plate, 40c. Windsor Specialty Co. (not incorporated), 5419 Windsor Ave., Chicago, Ill.

Castings, Blueprints, Engines—Gas and Steam, ⅛ H.P. up. Gears, Pulleys, Pumps, Fittings, Small Boilers. Complete circulars for stamp. Latest models. Universal Gas Motor Co., 364 Monadnock Block, Chicago.

Magnets: Large Horseshoe Magnets. Will lift 12 lbs. Mail $1, stamps or Money Order. Parcel Post Prepaid to all parts of U. S. or Canada. West Side Novelty Co., Drawer No. 8 Wabash P. O., Pittsburgh, Pa.

Electrical Workers and all others who are interested in Electrical Work in the Reconstruction that is taking place. To send us their name and receive descriptive literature of our Modern Blue Print Chart Method of Electrical Wiring. Souvenir information card included. Electrical Wiring Diagram Co., Box C. 173, Altoona, Pa.

Lava Insulation is not molded but individually sawn, lathe turned, milled, drilled, threaded. No limitation on form, only on size. Kilned at two thousand degrees. Hard, strong, accurate, fire, acid proof. Ask for book. American Lava Insulator Company, Chattanooga, Tenn.

Battery Charging pays big profits with HB Equipment. Electric Light Generators and Motors can also be furnished on easy payments. Full information free. Hobart Brothers, Troy, Ohio.

Motor Winders. See ad under "Blueprints." Charles Chittenden.

Electric Lighting Outfit for Sale—35 H.P. two-cylinder Fairbanks heavy duty engine, direct connected to C. & C. 27 K.W. generator. Engine runs with either gasoline, artificial gas, or natural gas. Weight, complete, about 12,500 lbs. Run about six months. Like new. Has carried 3,200 ten-watt lamps. Price $2000.00. Maning Cleveland, Room 4 Cleveland Bldg., Academy St., Poughkeepsie, New York.

Blueprints

Blue Prints, 236 A.C. diagrams, contains 54 single phase, 42 two phase, 50 three phase Star, 40 Delta, 12 Star-Delta. Appendix 68 changes of voltage, phases, speed, cycles, etc. 10 samples 25c. Particulars free. Charles L. Chittenden, 811 West 18th Street, Kansas City, Missouri.

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1,000 Letterheads, Envelopes, Typewriter Letters, $2. Circulars, Labels, $1; samples. M. Lomond, 65 Broadway, Brooklyn, N. Y.

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Send us your dull razor blades. We re-edge them Good as New, any kind, 2½c each. Prompt service and satisfaction guaranteed. Dealers wanted. Keenedge Company, Inc., 184 Washington St., Chicago, Ill.

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20c Year "Popular Boy Magazine." 62 West First Ave., Columbus, Ohio. Display advertisements $1 per inch.

Books on Sex—For men and women. Catalog free. United Sales Co., Springfield, Ill.

Books. Practical Mechanical, Auto, Aviation, Home Study Books. Easy payments. Send dime "tonight" for catalogs. Amsco, Dept. EI, Aurora, Ill.

Laws of Nature every married and engaged person should know. 50c (no stamps). Central Co., 599 Ninth Ave., New York.

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Will Pay 40c for a good copy November, 1918, Electrical Experimenter. Address Burnie Lazette, 49 Kentucky Ave., Monroe, Mich.

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Telegraphy (both Morse and wireless) and Railway Accounting taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School—est. 45 years. Catalog free. Dodges Institute, 7th St., Valparaiso, Ind.

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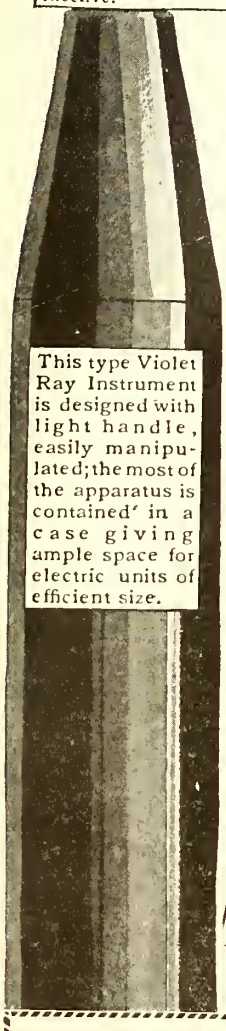

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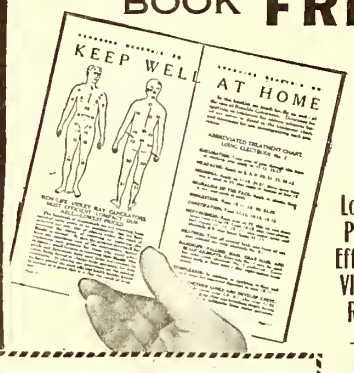

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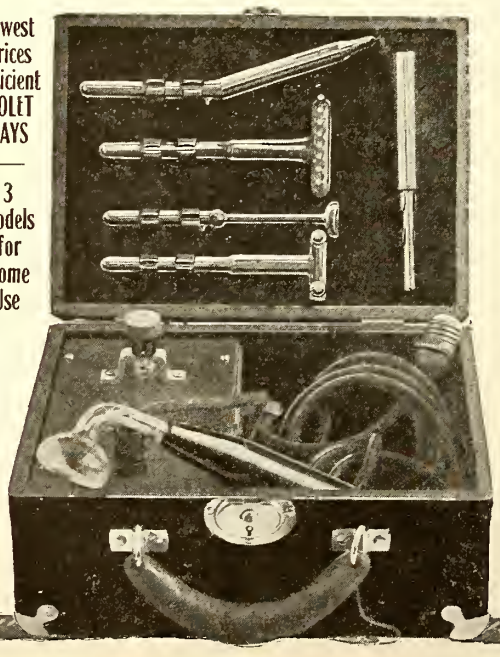

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